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ARMY ORDNANCE

VOL. VII WASHINGTON, D. C., SEPTEMBER-OCTOBER, 1926 No. 38

TESTING SEACOAST GUNS, ABERDEEN PROVING GROUND

EIGHTH ANNUAL MEETING, ARMY ORDNANCE ASSOCIATION
Aberdeen Proving Ground, Md., October 8, 1926

THE ABERDEEN PROVING GROUND
Lt. Col. C. M. Wesson, Ord. Dept., U. S. A.

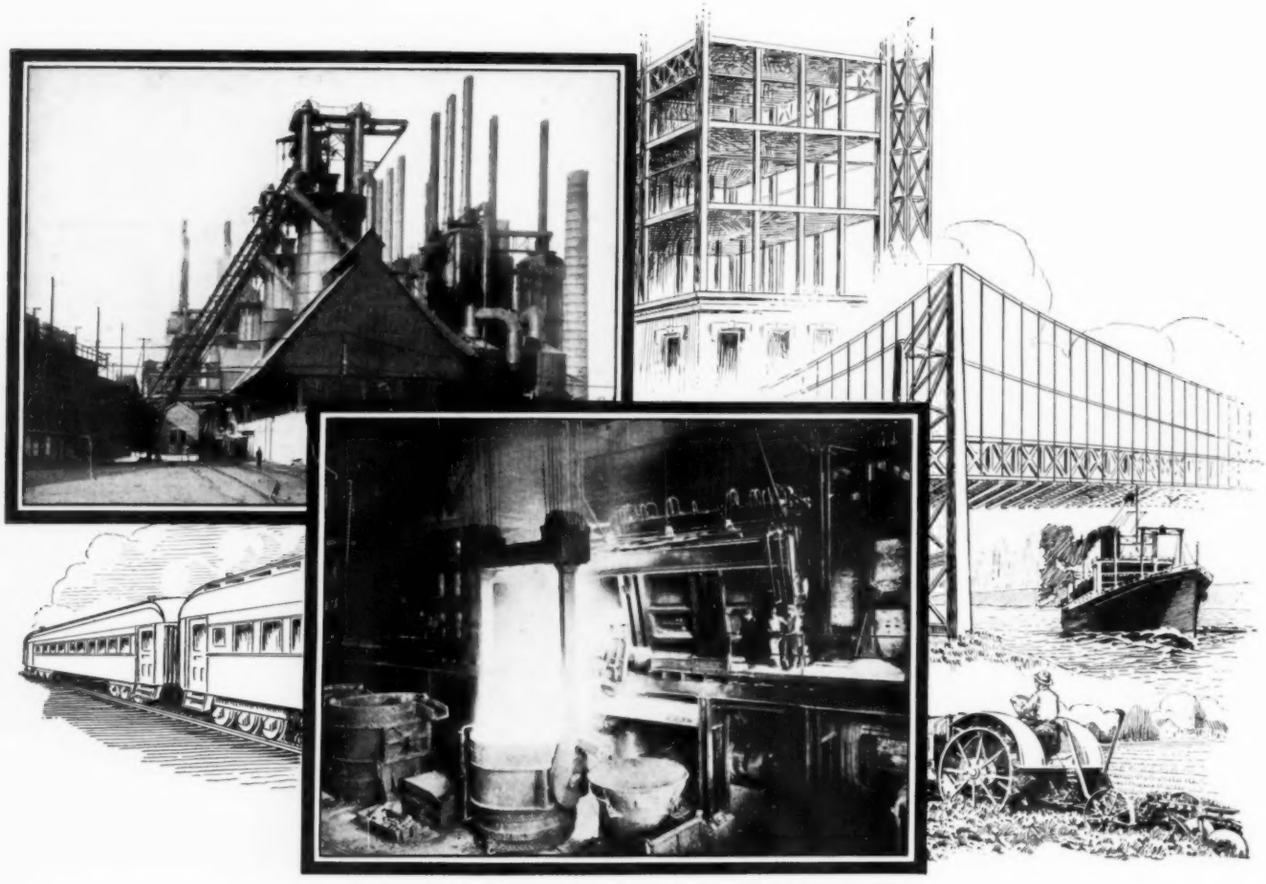
RESERVE OFFICERS' ASSOCIATION OF THE UNITED STATES
Brig. Gen. John Ross Delafield, Ord. Res., U. S. A.

AMERICAN INDUSTRY IN PEACE AND WAR
D. M. Edwards

INDUSTRY'S INTELLIGENCE DEPARTMENT
Magnus W. Alexander

INSTRUMENTS FOR MAKING BALLISTIC DETERMINATIONS
Maj. Arthur W. Ford, Ord. Dept., U. S. A.

THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION



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ARMY ORDNANCE

THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION

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Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guarantee of Peace

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THE EIGHTH ANNUAL ORDNANCE

WILL BE

THE ABERDEEN PROVING OCTOBER

The National Association of Manufacturers,
The American Society for Steel Treating,
of the United States

TENTATIVE PROGRAM

OCTOBER 8, 1926

9:30 A. M.	Arrive Aberdeen Proving Ground.
10:00 A. M.	Mulberry Point—Opening Exercises.
10:20 A. M.	Demonstration of coast artillery and antiaircraft matériel.
11:30 A. M.	Aviation Field—Aircraft, aircraft armament and bombs.
12:00 M.	Dinner.
1:30 P. M.	Main Front—Automotive demonstration.
3:00 P. M.	Main Front—Mobile artillery demonstration.
5:00 P. M.	Administration Building—Business meeting of the Army Ordnance Association — All guests are invited to attend.
6:00 P. M.	Supper.
7:00 P. M.	Main Front—Antiaircraft and pyrotechnic demonstrations.

(Detailed program of all events will be distributed at the Meeting.)

Reduced Railroad Fare

Members of the Army Ordnance Association, the National Association of Manufacturers, the National Industrial Conference Board, the Reserve Officers' Association of the United States, and the American Society for Steel Treating, can travel to the meeting at reduced fare by presenting their Identification Certificate to the local railroad ticket agent at practically any point in the United States. Certificates have been sent to all members. A round-trip ticket to Aberdeen, Maryland, purchased under this plan will cost one and one-half times the one-way fare.

Special Train

A special train of Pullman sleeping cars open for occupancy at 10 o'clock will leave Pennsylvania Station, New York City, shortly after midnight, October 7th, arriving at Aberdeen Proving Ground for breakfast. Returning this special train will leave the Proving Ground after the night demonstrations and will arrive in New York in time to make midnight connections for other points. Capt. H. W. Churchill, Secretary, New York Post, Army Ordnance Association, 39 Whitehall St., New York City, will make reservations for those who desire to travel on this train.

MEETING OF THE ARMY ASSOCIATION

HELD AT

GROUND, MARYLAND

8, 1926

The National Industrial Conference Board,
and the Reserve Officers' Association
Will Participate

TRAIN SERVICE

Trains as numbered, will stop at Aberdeen on October 8th. Consult time-table for possible minor changes in time.

GOING

Southbound—	Pennsylvania	Baltimore & Ohio
Leave Philadelphia:	Train No. 405	Train No. 15
Broad Street	7:20 A. M.	.....
West Philadelphia	7:25 A. M.	.....
Wayne Junction	.....	7:45 A. M.
24th and Chestnut Sts	.....	8:02 A. M.
Arrive Aberdeen	8:56 A. M.	9:26 A. M.
Northbound—	**Train No. 110**	**Train No. 4**
Leave Washington	7:25 A. M.	7:15 A. M.
Leave Baltimore:		
Union Station	8:23 A. M.	.....
Camden Station	.....	8:07 A. M.
Mt. Royal Station	.....	8:12 A. M.
Arrive Aberdeen	8:57 A. M.	8:51 A. M.

RETURNING

Northbound—	Train No. 134	Train No. 26
Leave Aberdeen	8:29 P. M.	9:00 P. M.
Arrive Philadelphia:		
West Philadelphia	9:55 P. M.	.....
Broad Street	10:00 P. M.	.....
24th and Chestnut Sts	.....	10:40 P. M.
Arrive New York	12:25 A. M.	.....
Southbound—	**Train No. 129**	**Train No. 9**
Leave Aberdeen	8:40 P. M.	8:20 P. M.
Arrive Baltimore:		
Mt. Royal Station	.....	9:03 P. M.
Camden Station	.....	9:08 P. M.
Union Station	9:25 P. M.	.....
Arrive Washington	10:25 P. M.	10:00 P. M.

Reservation of Meals

THE COMMANDING OFFICER, ABERDEEN PROVING GROUND, MARYLAND:

I desire to attend the Eighth Annual Meeting of the Army Ordnance Association, to be held at the Proving Ground, Friday, October 8, 1926, and I request that you reserve ..... dinner ($1.50 each) and ..... supper ($1.50 each) for me on that day. I am enclosing my check for ..... drawn to your order.

Please send Meal Ticket to:

.....

(Member A. O. A.)

.....

(Address)

NOTE.—This reservation must be mailed to reach the Proving Ground not later than Monday, October 4, 1926. Since all food is shipped from Baltimore by a caterer, it will be impracticable to refund for meals once ordered.

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Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guarantee of Peace

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¶ The time has passed when military preparedness can be considered merely a question of trained man-power. The development of the methods of modern warfare must be supplemented with a knowledge of the methods of production of modern implements of war. Experience has shown that men can be mobilized and reasonably trained in from three to six months if the necessary ordnance is available. Industry today requires for mobilization and mass production of war material a period of from nine to eighteen months. The mobilization of the munitions industries is the ordnance problem.

¶ The industries of America know perfectly well how to house, to feed, to clothe, to transport men called to the colors. The civilian professions of medicine, surgery, dentistry, law and banking similarly develop great reservoirs of readily available personnel for preserving and restoring the health of an expanded army, for administering its judicial system, and for paying it.

¶ But, a man, even a man of military training—well fed, well housed, well clothed, well paid, is not a soldier until he receives the tools of his trade—ORDNANCE.

The Constitution of the Army Ordnance Association provides:

ARTICLE III

MEMBERSHIP

"Sec. 1. Full membership in the Army Ordnance Association shall be open to all men who are American citizens and who are interested in promoting the cause of industrial preparedness, particularly in connection with the design, procurement, production, manufacture, inspection, test or supply of Ordnance material."

For further particulars address

The Secretary, Army Ordnance Association
806 Mills Building
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Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guarantee of Peace

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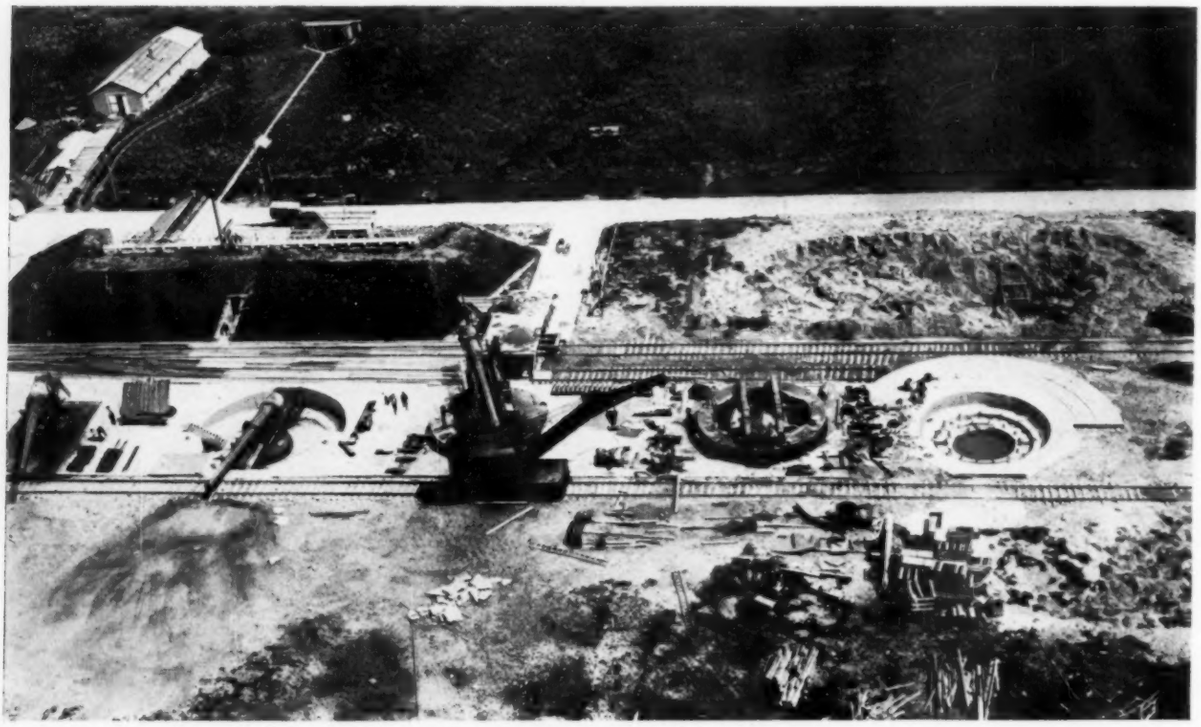
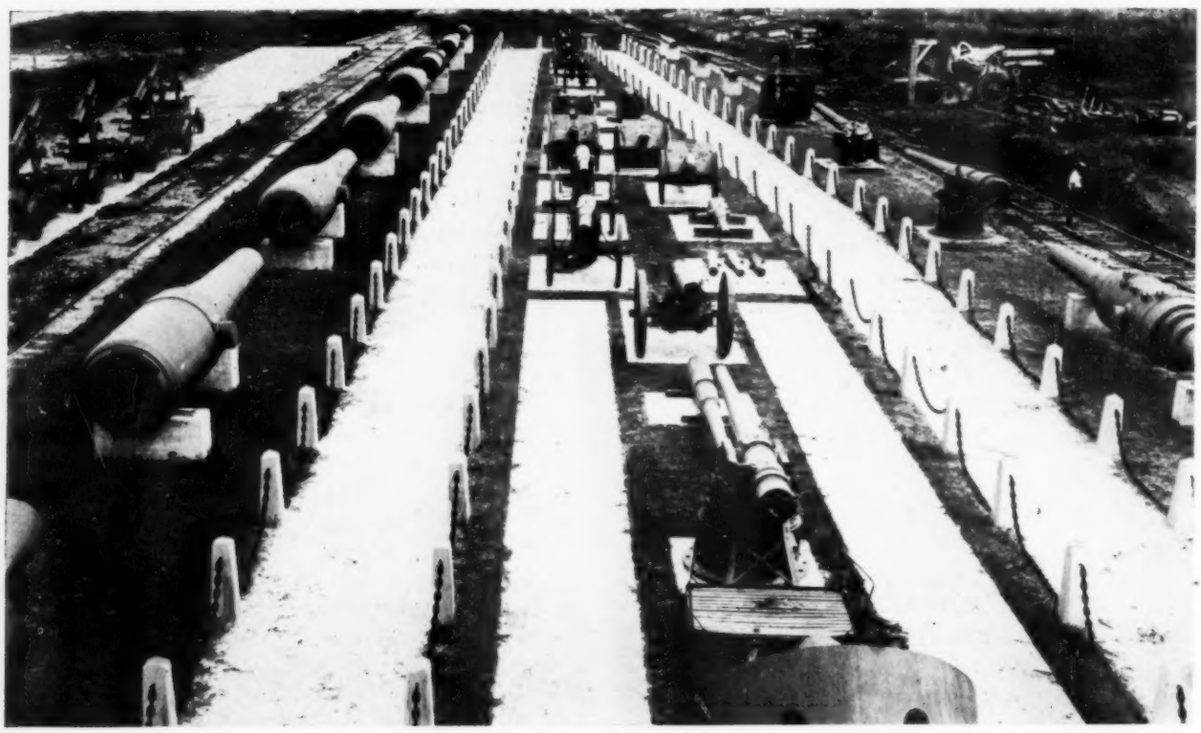
ABERDEEN
The Great Ordnance Proving Ground



The Seacoast Batteries at Aberdeen

A partial view of the Seacoast Front at Aberdeen Proving Ground where the major caliber guns for coast defense are tested.



The True and the Tried

A partial view of the outdoor Museum at Aberdeen Proving Ground where are on exhibit standard guns of former days and those that were tried and found wanting.

The Aberdeen Proving Ground

Its Mission in Our System of National Defense Together with a Brief Historical Sketch

Lt. Col. C. M. Wesson, Ord. Dept., U. S. A.

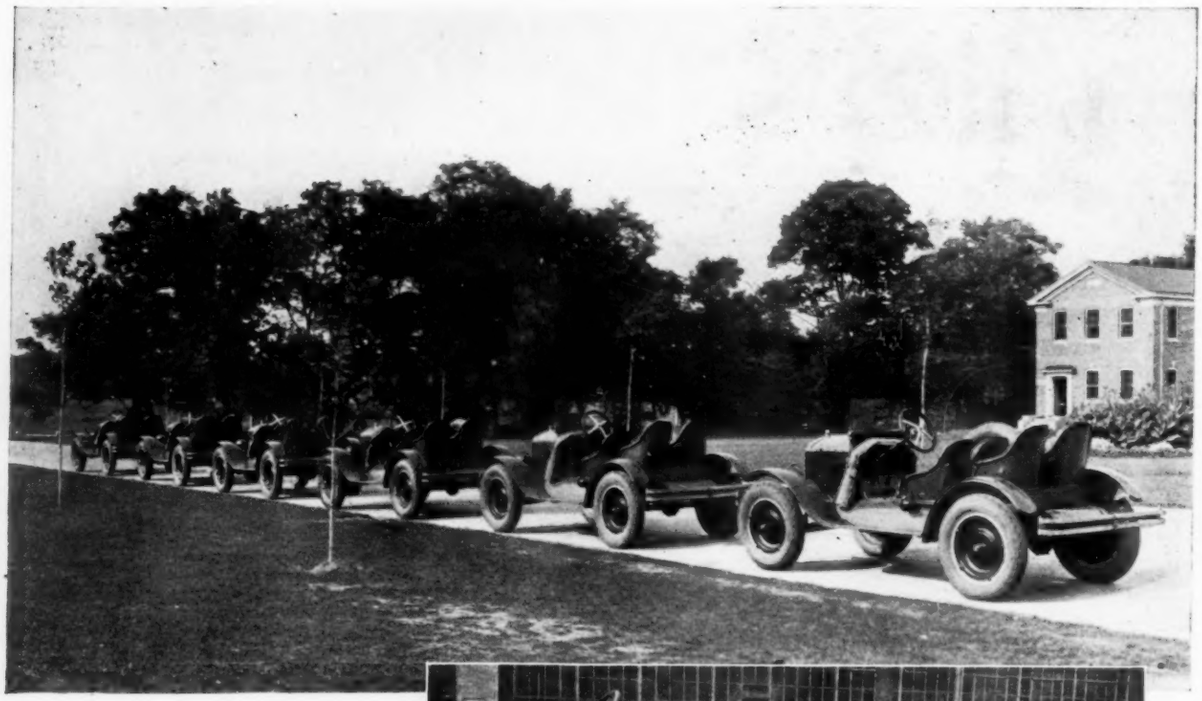
THE Aberdeen Proving Ground is an establishment of the Ordnance Department of the Army under the jurisdiction of The Chief of Ordnance and is the only Proving Ground operated by and for the Army in time of peace. In our system of national defense the work performed there is of a character which may not be generally understood and appreciated, for it has an important bearing not only upon the matter of assuring to the War Department that the ammunition, bombs, guns, and other material issued to our troops is of the established quality, but also it is vitally concerned with the development of new and improved types of ordnance, which are being made constantly, so that our knowledge may keep abreast of the times and, should an emergency arise, our country may have available the most modern achievements in munitions and at once can undertake to equip our armies with matériel of equal or superior efficiency to that of the enemy. It is here also that many Reserve Officers of the Ordnance Department and Ordnance R. O. T. C. students receive their practical training.

LT. COL. C. M. WESSON, Ord. Dept., U. S. A.
Commanding Officer, Aberdeen Proving Ground

The Ordnance Department of the Army is one of the major branches of the War Department, maintaining in time of peace, in addition to the Proving Ground, some fifteen other establishments located throughout the country. Its responsibility to the War Department is to design, develop, procure (which includes both purchase and manufacture), test for acceptance (that is, determine whether the product is up to the perscribed standard), store and issue, and maintain and repair both in the hands of troops and in storage all ordnance. This latter term comprises every type of artillery and ammunition, bombs, aircraft armament, tanks, tractors, trailers, and certain fire control instruments. It is also charged with the training of Reserve Ordnance Officers, other than those assigned to tactical organizations, which is a most important phase of its work in connection with National Defense. Work at the Proving Ground, as has been pointed out, deals principally with three of the foregoing activities, to-wit: development and acceptance tests and the training of reserve personnel.

The process of development of a new or improved type of Ordnance matériel is, of necessity, a long one. When a need arises for some new type of ordnance, a board, known as the Ordnance Committee, consisting of line officers and ordnance officers, establishes what may be called the tactical and strategical specifications. To illustrate in the case of a field gun and its mount, this Board prescribes the range desired, the weight of projectile, a limit to the total weight, the amount of traverse and elevation desired, mobility, road space, and other of the outstanding characteristics of the matériel. If the development of this matériel is recommended by the Chief of Ordnance and approved by the General Staff, a design embodying these so-called tactical and strategical requirements is laid down, a pilot or type made, which, after certain shop tests at the place of manufacture, is sent to the Proving Ground for an exhaustive proof trial. The tests made in this trial are in conformity with a program prepared by the Technical Staff of the Ordnance Department, an advisory body to the Chief of Ordnance, one of whose functions is to conduct programs of all trials of pilot ordnance matériel. The prime object of such tests is to determine any structural weaknesses or any faults in connection with mechanical operation, and also to determine whether the matériel is satisfactory as to range, etc. This procedure is followed in the case of all Ordnance material, no matter how simple or how intricate.

The Proving Ground may be termed a fact finding laboratory. Tests are made from the engineering, rather than the tactical or strategical, standpoint. Care and pre-

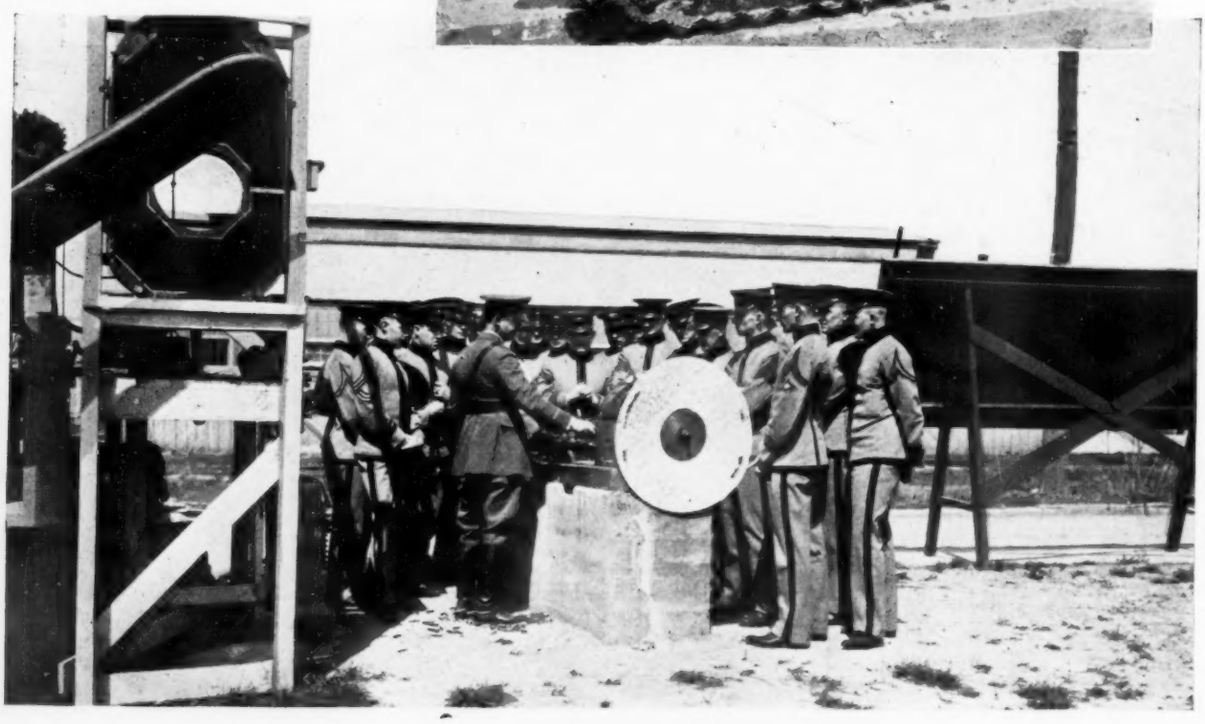


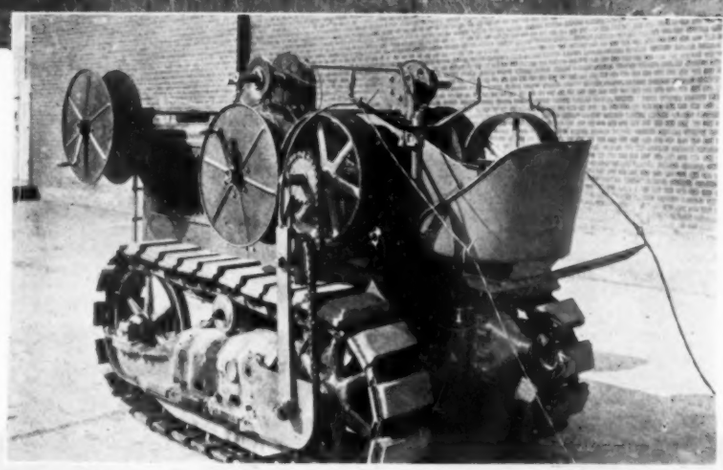
Ordnance Under Test at Aberdeen Proving Ground.

Above: A "herd" of Ford Cross-Country Cars ready for a gruelling drive to determine their ability to perform some of the tasks of the horse in warfare.

Center: A Mead-Morrison "55" tractor after four miles of operation.

Below: Members of the First Class, U. S. Military Academy, are shown some of the complexities of the synchronizing mechanism for aircraft machine guns.



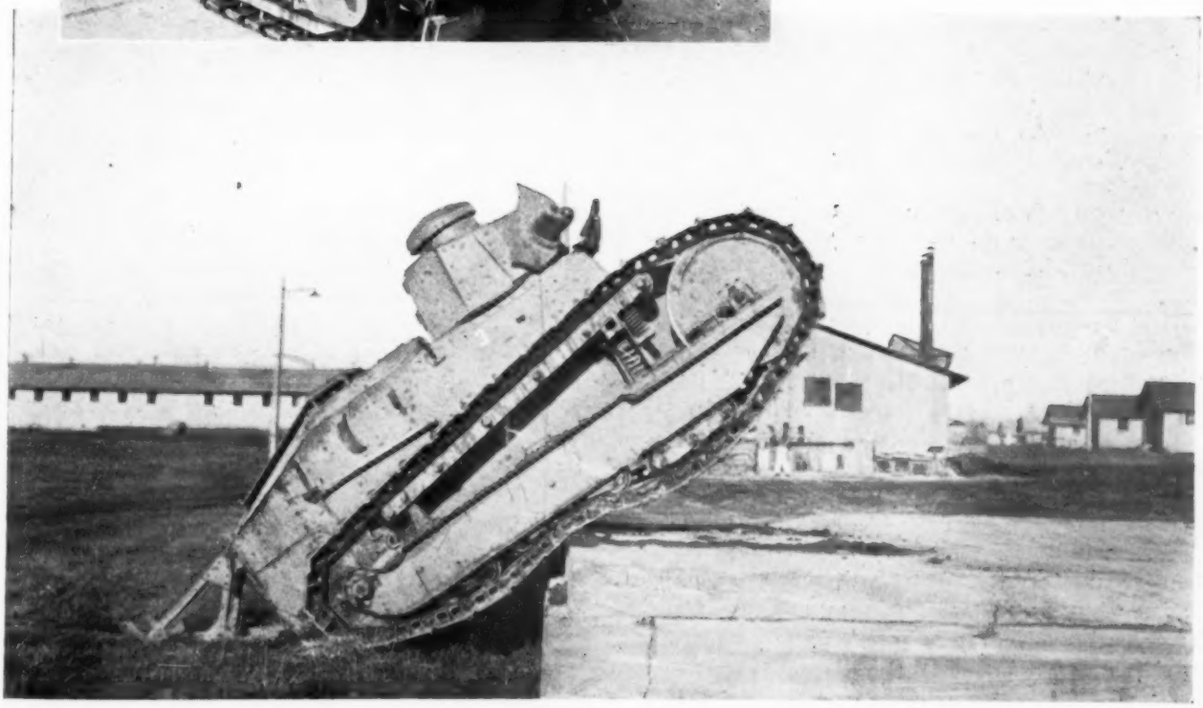


Ordnance Under Test at Aberdeen Proving Ground.

Above: Caterpillar Tractor drawing T-2 Cargo Carts loaded with 3,000 lbs. of tentage.

Center: T-35 Caterpillar Tractor equipped with wire-laying attachment—an experiment to determine the applicability of the tractor in laying telephone and telegraph wires, a present function of the Army mule.

Below: An American 6-ton Tank mounting a 32-inch concrete foundation.



cision are required in the work and no fact, however unimportant it may seem, is left recorded in the process of testing. Experience has shown that at times seemingly unimportant facts prove later to be most important. The work demands personnel of a high order not only in the execution of the tests but in analyzing the results obtained. When tests have been completed at the Proving Ground, the material which has, up to this time, been entirely in the hands of the Ordnance Department is turned over to the using service for such field and tactical tests as may be desired, and it is only upon the completion of these tests, followed by recommendations from The Chief of Ordnance and chief of the using service, i. e., the Field Artillery in case of a field gun, the Infantry in case of a small arm, etc., that the material is approved by the General Staff as a standard for future manufacture and issue to the service. The cycle described is sometimes repeated more than once before a satisfactory solution is obtained. Closely related to development tests of special material are tests of general application in the field of exterior and interior ballistics and automotive design. Many programs governing such tests are carried on at all times at the Proving Ground.

As to the second principal function of the Proving Ground, that is, conducting tests for acceptance of matériel, these consist in subjecting standard matériel which has been manufactured or procured by the Ordnance Department to those definitely prescribed proof tests which are laid down for guns, ammunition, and all Ordnance of every description to determine whether the matériel functions properly and meets the prescribed standards set forth in the specifications governing their manufacture. For example, propellants procured under contracts must meet a required performance as to pressure and velocity in the gun for which intended, fuzes have to be tested for premature effect; timing function, burst on impact; guns must stand up under stated powder pressure, etc. Purely physical and chemical tests are made elsewhere. Tests at the Proving Ground are essentially practical and are made by actual performance of the matériel in the manner for which intended.

The appliances used in Ordnance tests are, in general, peculiar to this class of work. The commercial field cannot therefore be drawn upon to supply the special apparatus required. It is incumbent upon the Proving Ground to improve existing apparatus and develop new apparatus for testing which is an important activity in itself, because the trend of development in Ordnance matériel is steadily along more scientific and improved mechanical lines, and this results in a constant demand for new and improved apparatus for conducting Proving Ground tests. A description of this class of work appears in an article by Maj. A. W. Ford, Ord. Dept., U. S. A., in this issue of Army Ordnance.

Since we accumulated large quantities of various types of ordnance material during the late war, there has been, since the Armistice, but an inconsiderable amount of ordnance fabricated for issue to the service. On the other hand, however, as a result of war experiences there has been given a great impetus to the improvement in the design of ordnance to secure greater accuracy, greater range, and greater destructive effect, etc., in the case of established types and to the development of many new types of ordnance not in general use until late in the World War. So, as a consequence, the principal work which the Proving Ground has undertaken since the Armistice is that work which deals with the development of new and improved types of matériel. Its functions in the matter of acceptance tests have not been very active. In war time, however, the conditions would be quite reversed. While development would not entirely cease in time of war, yet a very large percentage of the amount of work to be done by the Proving Ground would be in making acceptance tests of material produced by contractors for the Army in order to determine its suitability for issue to the service. In a war of major proportions, additional proving grounds would have to be put into commission.

On account of its location, spaciousness, character of work performed, fine summer climate and facilities for recreation, such as baseball, golf, tennis, and swimming, the Proving Ground was selected as the establishment for the practical training of Ordnance R. O. T. C. and for the basic training of Reserve Officers of Ordnance in the Branch Assignment Group. Each summer some 200 of both of these groups are sent there for training, and during September and October of the present year a regiment of Antiaircraft Coast Artillery will be stationed there for training in antiaircraft firings, using the latest developments in antiaircraft guns, mounts, and range finding instruments. A tour of duty at the Proving Ground is considered essential in the training of all Regular Ordnance Officers. By conducting tests is obtained an intimate and special knowledge of ordnance that can be obtained by no other means. Also at the Proving Ground is a museum of obsolete types and of foreign types which affords a means of tracing the development of material and is of paramount value to officers specializing in design work.

For many years prior to the entrance of the United States into the World War, practically all experimental and proof work in connection with ordnance was conducted at the Proving Ground at Sandy Hook, N. J. Early in the late war, however, it became evident that the facilities and space available at Sandy Hook were inadequate and that a vastly greater area would be necessary to carry on the proof work incident to the large program for the production of ordnance necessary to meet the requirements of our armies. Several proving grounds were placed in operation, including the Aberdeen Proving Ground, which was built with a view to replacing the one at Sandy Hook at the termination of hostilities. Like many of our present War Department establishments the Aberdeen Proving Ground is an outgrowth of the World War.

A permanent Proving Ground should be reasonably accessible to the munition producing centers of the country, of sufficient extent to carry on tests of the longest range guns and should have a moderate climate so as to permit of operations at all seasons. It should be flat so as to permit of the observation of projectile impacts. It should permit of firings both over land and water and be sufficiently remote so as to not endanger or disturb life and property in adjacent communities but be near enough to populated centers so that the necessary personnel can be obtained and local housing avoided. These conditions are fulfilled by the Aberdeen Proving Ground, and it was these qualifications which determined its selection for a permanent proving

ground in preference to other localities which were considered available at the time. It contains about 35,000 acres and is approximately 15 miles long and 4 miles wide. It is located on the northwest shore of the Chesapeake Bay about four miles from the town of Aberdeen, Md., which is half way between Washington and Philadelphia and through which pass the main lines of the Pennsylvania and Baltimore and Ohio Railroads.

From the gun positions along the main firing front a land range of 30,000 yards can be obtained, while from a special range devoted to the test of railway and seacoast artillery, the same land range is available, and a water range up to 60,000 yards. In order to observe firing at long ranges over the water, there are range towers located at intervals along the eastern shore of the Chesapeake Bay for a distance of 25 miles from this firing front.

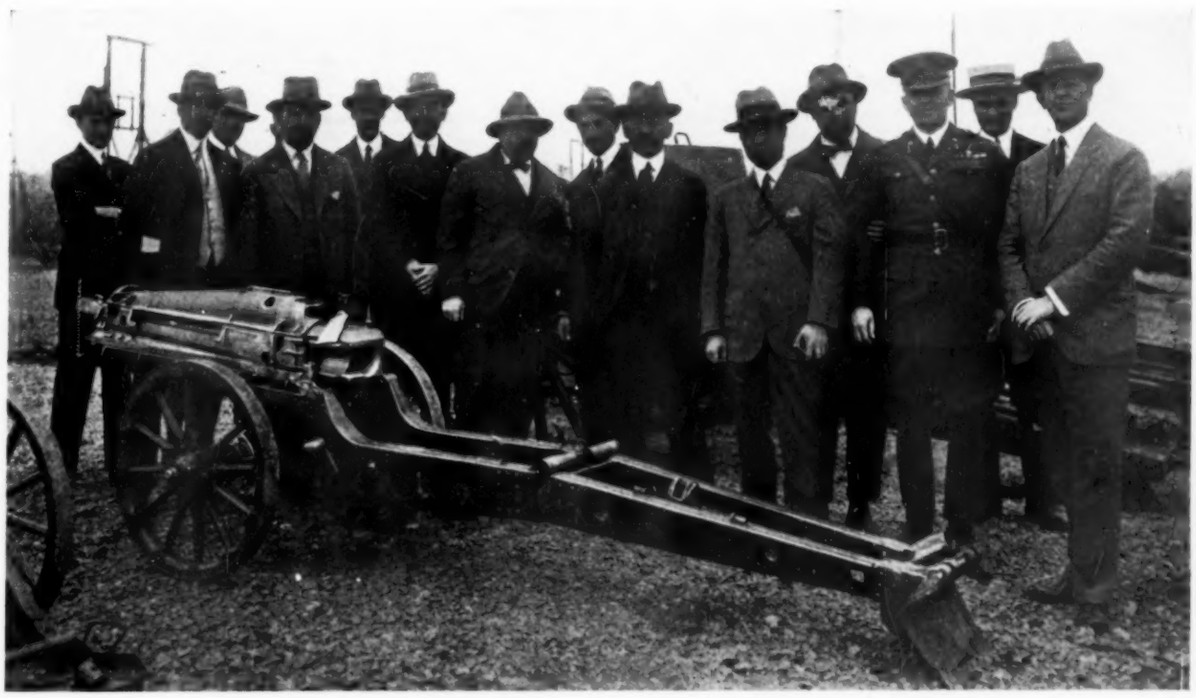
In addition to the facilities for testing artillery and ammunition, special facilities are installed for test of tanks, tractors, and motor gun carriages, including a dynamometer laboratory for the test of gas engines and various types of transmission, and an oil laboratory for the test of lubricants. Courses have been laid out for the test of automotive vehicles operating over different classes of roads: sand, concrete, unimproved country roads, etc.

There have been constructed since the Armistice special apparatus and towers for observing the fall of bombs from airplanes, an activity for which a large area at a remote place on the Proving Ground has been set aside. To assist in this work a fully equipped bombing squadron of the Air Service is permanently located at the Proving Ground and an excellent flying field with hangars and repair shops has been completed.

A special small arms range of 6,000 yards has been in operation for the past few years, made necessary by the increased ranges obtained with the latest developments in small arms projectiles.

Adequate shops for local maintenance and minor repairs to equipment exist as well as numerous storehouses and magazines in which are stored large quantities of War Reserve material. These are connected by a network of railroad aggregating 17 miles in length.

Since the Armistice the organization at the Proving Ground has shrunk from 272 officers, 4,000 enlisted men and 1,200 civilian employees to 40, 250 and 375, respectively. The character of the work performed is, however, more varied than formerly and new problems are constantly arising which tax the ability and skill of its trained personnel.



Representatives of Foreign Governments Visit Aberdeen Proving Ground.

Among those shown in the photograph are Captain Hetherington, Air Attaché, Great Britain; Major Garñas, Military Attaché, Chile; Col. N. E. Margetts, Gen. Staff, U. S. A.; Captain Prieto, Military Attaché, Cuba; Major Alston, Assistant Military Attaché, Great Britain; Captain Stopford, Naval Attaché, Great Britain; Mr. Diamantopoulos, First Secretary, Greek Legation; Captain Isoda, Assistant Military Attaché, Japan; Major Casajus, Military Attaché, Spain; Lt. Col. C. M. Wesson, Ord. Dept., U. S. A., Commanding Officer, Aberdeen Proving Ground; Col. W. H. Tschappat, Ord. Dept., U. S. A., Chief, Technical Staff, Office, Chief of Ordnance; and General Villa, Military Attaché, Italy.

American Industry in Peace and War

D. M. Edwards

Publisher, National Association of Manufacturers

WARS will cease when the Christian religion makes this world a brotherhood of men and nations; when the human mind reaches the higher realization that upon man was bestowed a Divine obligation to think and to develop from a savage into a satisfied individual at peace with all his fellows.

Until that time comes, the family will need its strong guide and protector; the village its constable; the city its police force and the nation its army, to be ready to meet strife from within and agression from without. And as with the family so with the nation. The man who bulwarks his home most strongly against physical and economic ills, is the strongest in the community; the village whose constable is most feared by maurauders is the safest; the city with the most efficient police force supported by an upright judiciary is the least infested by criminals; and the nation with the most modern equipment, actually or potentially, for defense or offense, is the last to feel the iron hand of the conqueror or know the yoke of conquest.

JOHN E. EDGERTON
President, National Association of Manufacturers

Geographically, the United States occupies the most fortunate position in the whole world, for ostensible peace at home and safety against invasion from abroad. On its northern border is an industrious nation with whom we have been at peace for nearly two centuries. With kindred tastes, kindred ambitions, kindred felicity, there has never been the slightest cloud on that horizon and never a single threatening weapon along the more than three thousand miles of border line. On our south is a less fortunate nation, usually so torn with its own national emotions, that it could not enter into a vigorous campaign with any great nation; yet even here, along more than two thousand miles of border, we have only a few border posts that serve perhaps more as customs ports of entry than as military danger signals. Moreover, at most of these posts there is an atmosphere of the utmost friendliness with the people on the other side of the line.

Thousands of miles of ocean separate us from any ambitious nation across the western waters and from the turbulent European center that has fomented so many wars. And on the latter side of the Globe we have a constantly growing and firmer friendship with the greatest of those nations, a friendship cemented by racial, commercial and financial ties that naturally bring us closer together than any other two nations of the world.

But geographical safety does not mean international safety. The United States has been, and is striving always to be, a nation of domestic and industrial tranquillity. It will remain so, just as long as its physical developments and resources, keep it where it can match or outstrip any other nation in the world in offense or defense. Our army and navy are our international police force and while every manufacturer in the country would gladly welcome the day that meant the end of all warfare and believes that the reduction of armaments would be an act of intelligence and courage, he just as strongly believes that our army and our navy should always be maintained at the very highest point of practical readiness; should be properly provided with the latest instruments for defense against war; should be encouraged and supported in their scientific and mechanical researches; and should be developed to the highest degree, not in numbers, but in efficiency and advanced military knowledge. To throttle the army or navy so that either is left inadequate for national defense would be an act of supreme folly. Such action would

not only place the country in international danger but would subject it perhaps to greater jeopardy from within, for the very thought that Uncle Sam has at his call some hundreds of thousands of a well-equipped diciplinary force, undoubtedly has fortified it against organized destructive forces within its borders.

Napoleon's army traveled on its stomach. But those days are past. The modern army travels on its brain and the brain of industry back of the line. Ancient and near-modern armies have been defeated by pollution of the water supply or cutting off of food; and those days are past. The modern armies can be defeated only by masses of men or by cutting off some vital industrial supply. It has been said by army officers of competent knowledge that perhaps the greatest contribution to the defeat of the German army was the depletion of three main supplies—nitrate, which reduced the efficiency of its powder; copper, which impared its lines of communication and forced it to make shell casings of steel and iron; and rubber, which reduced its motor transportation to an appalling degree because of lack of tires.

Should war unhappily come again it will be won by masses of men at the front and the massed intelligence of industry back of the lines. We all saw the terrible price we paid for our lack of preparedness in the World War. Had our nation been as well equipped when it entered the war as it is today, instead of taking eight or nine months to get into action, it would have meant the saving of a million or more lives and millions of dollars worth of property.

Poorly prepared as we were in the military field we were even more at a disadvantage in the industrial field. Probably most of the great waste in our war effort was due to lack of industrial organization for war and to the necessary improvisation of war-time machinery. We had no sufficient airplane, shipbuilding, munitions and chemical industries in 1917 and our natural resources could not be brought into play quickly enough or intelligently.

Forts, fleets, armies and navies are the nation's safety devices. Behind airplane development, warship and merchant ship construction, munitions production, transportation and chemical development, there must be adequate peace industries capable of coordination and rapid expansion for war needs. And practically all peace industries are called into play for war emergency.

American industry played its part in the war in a way that astounded the world by its speed. The heads of great and small establishments marshalled their brains and their energy in a common cause and loyally turned their entire plants to the task. Many of them so completely converted their organizations that when the war was over it was impossible readily to reconvert them to peace-time standards and they thus contributed heavily in millions of dollars for their patriotic efforts. Some of the industries were practically wiped out by substitutes that were necessary for certain needs and were found, when peace came, to be better than the original product for various uses. For every manufacturer who made unusual profits there were probably just as many if not more who met with heavy losses that have required all the succeeding years to recoup.

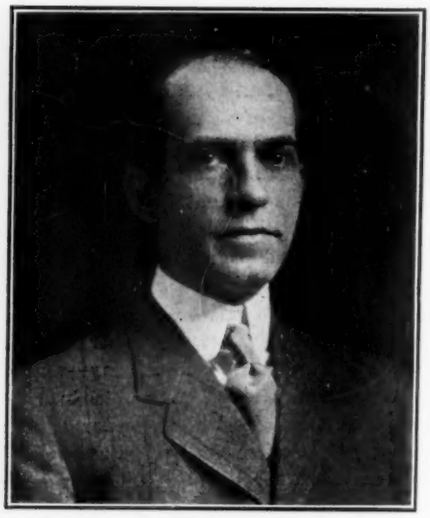
But that creditable performance of industry, working from a chaotic starting point and coming out successfully, will be dwarfed into insignificance if there should be another war which, if it occurs, will be waged upon the most advanced scientific and mechanical scale. Industry is as much obligated to be prepared for international emergency as our army or our navy; for neither of our great military arms will be of strength unless industry keeps apace with the latest developments in the world in all lines. We have nothing to fear in this respect because to inventive American genius can well be credited many of the revolutionary developments in war instruments. Gatling and Hotchkiss, with their machine guns, crude but effective, were the forerunners of Colonel Lewis's famous "hose of death" that was manufactured by the millions by England in the late war. All were Americans. The captive balloon as a means of scouting was first used by the United States Army in the Civil War, and it was then that Count Zeppelin got his inspiration for his steerable balloon. Through special permission of President Lincoln he was permitted to make an ascent in a balloon of the northern army before Fredericksburg. His observations led him to believe that armies could be defeated through the air, but, much more importantly, he had a thought for the commercial value believing that great dirigible balloons could be constructed to carry freight and passengers. And parallel with Zeppelin's thought and balloon development, Langley jumping off the Potomac hills and falling into the water, gave to the Wrights and Curtisses and other latter-day scientists the greatly efficient airplane of today—a machine capable of tracing an army long before it is brought into homogeneous formation. And the Monitor and the Merrimac, both American devices, revolutionized sea fighting, protecting the men behind iron-clad barricades instead of wooden bulwarks. These were the forerunners of the great steel-clads of today. Likewise "the intelligent whale" a craft that would go under the water, and the other early American contraptions that eventuated into the giant submarines of today.

American industry can be relied upon to do its part in any emergency and, more than that, it is today cooperating fully with the Government in aligning its forces and its equipment so that in any future call it will be ready to spring into active production for war purposes overnight with a minimum of confusion and dislocation.

That is one of the reasons for the participation of the National Association of Manufacturers in the great and instructive meeting of the Army Ordnance Association at Aberdeen. Such intimate relation has industry to the mechanisms that go to make up an efficient army that its members gain increased value by refreshing their minds on the continually increasing spread of devices and methods necessary for war that are in common use in peace time.

The industry of the nation has met every national call with enthusiasm and loyalty. It has ever been the builder of the nation and its protector; and it is a noteworthy fact that the synachronization of the industry of the country, as represented in the National Association of Manufacturers, came about as the result of a national dilemma and a public appeal for help for the whole nation, then suffering greatly from a trade war. Business demoralization and the panic of 1893, which followed quickly and inexorably the passage of the Wilson-tariff-for-revenue-only bill, and which reached into every factory, business house and individual home in the country was the in-

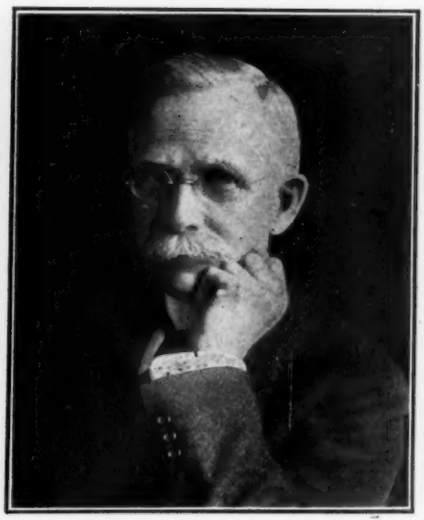
Officers and National Association



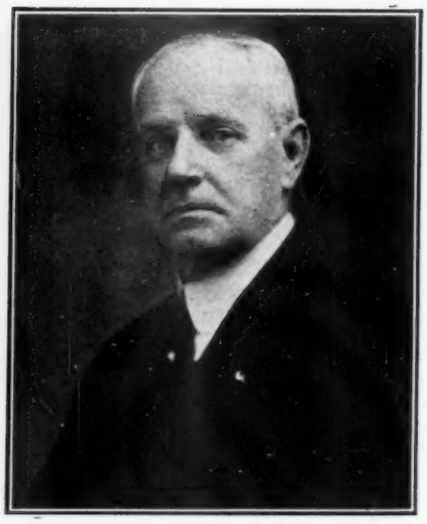
H. C. ATKINS, Director
E. C. Atkins & Company

WILLIAM H. BARR, Director
National Association of Manufacturers

A. H. MULLIKEN, Director
Pettibone Mulliken Company

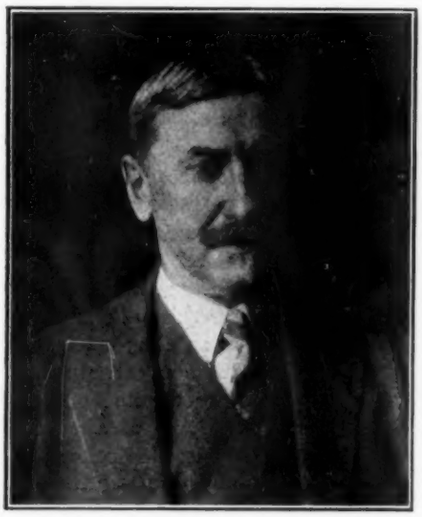


HENRY ABBOTT, Treasurer
Calculagraph Company

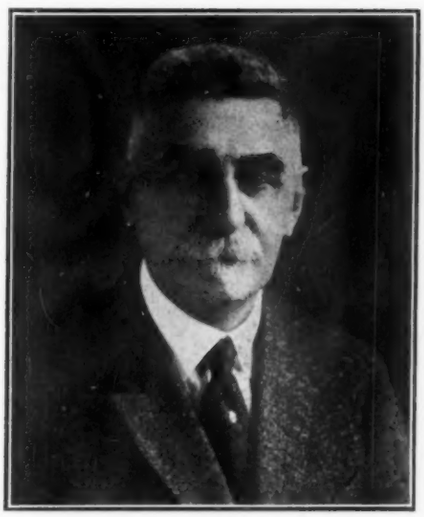


GEORGE S. BOUDINOT, Secretary
National Association of Manufacturers

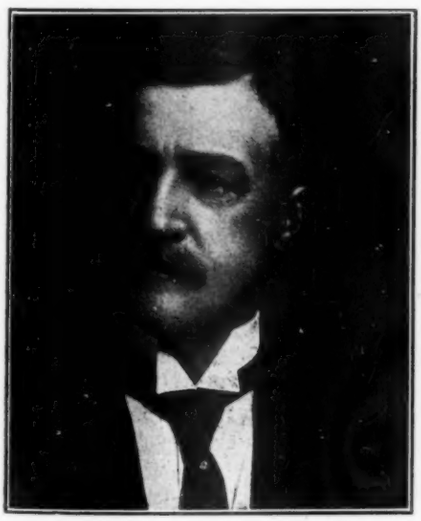
Directors 1926 of Manufacturers



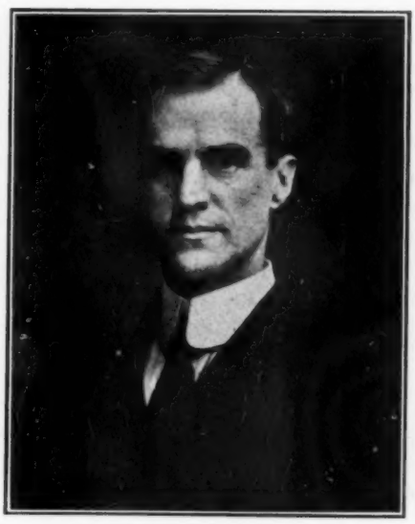
JAMES A. EMERY, General Counsel
National Association of Manufacturers



A. J. LINDEMANN, Director
A. J. Lindemann & Hoverson Co.



E. B. LEIGH, Director
Chicago Railway Equipment Co.



FRED ARN, Director
J. M. Card Lumber Co.

J. R. MILLAR, Director
California Cotton Mills

spiration. Depression was gripping the nation. The country was beset not only from within but from without, for the other great commercial nations were taking all of our trade. Great Britain had opened the Suez Canal and brought the fabled markets of India and far Cathay 10,000 miles closer to her shores than they were to ours. Her commercial fleet had run the famous American Clipper ships off the seas. International commerce was becoming a dead issue with us and, as if to revel in their own success, the chairman of the London Board of Trade, referred to the Wilson tariff bill in these words:

"We thank the great American, the Hon. Mr. Wilson, for our prosperity. He has lighted our fires and made our artisans busy at increased remuneration and wages, and has done more for England than the greatest Englishman of our country."

When things looked their blackest for the country, a southern magazine—*The Dixie Manufacturer*—in an editorial, suggested that, as this country was filled with men who had made great successes of great business and industrial establishments, they should come together and try to organize a way out for the nation. Thomas P. Egan, president of the J. A. Fay & Egan Company of Cincinnati, read the editorial and on his own initiative wrote letters to hundreds of industrial and business men, inviting them to meet in an effort to organize for national relief. Accordingly, 383 men met in Cincinnati in January of 1895.

Mr. Egan declared that "for every fire lighted in London and vicinity, two were banked and put out in America," and "more want, starvation and woe visited our American homes than ever took place in the same time before; more paupers and tramps were created than served in our great civil war in both northern and southern armies." He was talking to manufacturers who knew what he said was a fact; who had suffered, and were suffering, great losses trying to hold their forces together against better times coming.

The guest of honor was the Hon. William McKinley, then Governor of Ohio, and later president. Mr. Egan referred to Governor McKinley as "the author of the great McKinley tariff bill under which the whole United States prospered as never before."

Governor McKinley gave a vivid analysis of the situation, pointing to the fact that this was a nation built great through its industry and its industries, and that upon the substantial life of these depended the life of the nation and its manufacturing, commercial and agricultural industries.

"If we are wise or even ordinarily prudent as a patriotic, progressive people, our care must be constant and supreme that nothing is ever permitted to impair, much less destroy, our greatest manufacturing interests," said he. "Consider what they mean to the masses of the people. Their prosperity and happiness are both involved in them. If commerce would thrive, manufacturers must flourish. If agriculture would enjoy active markets and good prices, there must be conceded to enterprise and skill in manufacture just return for hazard and outlay. If artisans would receive good wages, they must be willing to pay fair prices to merchants and farmers.

"The moral of our present situation is that the prostration of manufacture is the downfall of all other business interest. We want our own markets for our own manufacturers and agricultural products; we want a foreign market for our surplus products which will not surrender our markets and will not degrade our labor to hold our markets. We want a reciprocity which will give us foreign markets for our surplus products, and in turn that will open our markets to foreigners for those products which they produce and which we do not. May you be able to devise some plan to improve our industrial situation and start this great country once more upon its march to triumph for the welfare of our own people and for the good of mankind everywhere."

Then, putting aside all circumlocution to arrive at immediate results, a permanent organization, with Mr. Egan as chairman, was formed to conduct the convention, which resolved itself into the National Association of Manufacturers. Immediately a general statement of principles was adopted, as follows:

1. To the largest possible extent our home markets should be retained and supplied by our own products and our foreign trade relations should be extended in every direction and manner not inconsistent therewith.

2. The principle of reciprocity should be embodied in national legislation, in accordance with the requirements of equity so that reciprocal trade relations between the United States and foreign countries may be developed and extended as far as practicable.

3. Believing that ships sailing under the flag of the United States should carry our entire maritime commerce, and in view of the injury thereto by subsidized foreign shipping; we declare in favor of a judicious system of subsidies in order to complete the restoration of our merchant marine.

4. The Nicaraguan Canal, being essential to the commerce of the United States, and of national importance, we favor its construction and operation under the control of the Federal Government.

5. Our national and artificial waterways should be improved and extended by the Federal Government to the full needs of commerce, connecting the Great Lakes with the rivers of the Mississippi Valley and the Atlantic Seaboard.

That was thirty years ago. The National Association of Manufacturers immediately applied itself to the task of opening up our trade routes and proffered its services to the Government in any endeavor looking toward the immediate construction of a canal across the Isthmus which would cut off 10,000 miles from our own ship routes to the far East, and place us on an equal footing with England in this respect. It held conventions on this subject and worked with the Congressional committees, for a canal whether through the Nicaragua Route, which at the time seemed easier of construction, or through the Panama route—but for a canal cutting the forty miles between the Atlantic and the Pacific. To overcome some of the burdensome inequalities of foreign trade, the Association held a great Reciprocity Convention in Washington, which resulted in the removal of many of the restrictions that fettered our commerce. And in keeping with the same trend of action, at its very first meeting it received a resolution calling for the establishment of a non-partisan tariff commission, which would take the work out of the hands of politics and place it under the jurisdiction of men fully qualified to do it.

With an organization pyramided on committees of experts in almost every line of industry and business it has repeatedly volunteered its best counsels to the government in determining the foremost industrial questions of the day. It maintains close contact with all the Federal departments through committees or special representatives chosen to meet particular requirements.

The Association always has believed in an adequate army and an adequate navy. Following the Conference on Limitation of Armaments the Association in 1922 passed a resolution urging upon Congress the necessity for maintaining the Navy of the United States at the ratio established by the treaty as necessary to the maintenance of our international standing, the security of the national defense and stimulation of the merchant marine. It also voiced strong opposition to the effort to reduce the Army below the limits of national safety.

Among the Association's other outstanding performances may be mentioned its unremitting campaign for the construction of the Panama Canal, between the Atlantic and the Pacific, a project now complete and on a self-sustaining basis; the successful advocacy of the establishment (accomplished in 1903) of a Department of Commerce and Labor, now two separate institutions; its signal success in the extension of our foreign trade, for the particular assistance of which the association maintains a large foreign trade department, with correspondents in all sections of the world; its constant insistence on the strengthening of our consular service, which had for years been one of the weakest arms in our body international; its successful campaign for the establishment of a parcels post service now doing a business for the government running into millions of dollars; its foremost activities for the development of an American merchant marine, constructed, owned and operated by Americans; its constant appeal for improvement in our immigration policy and methods so that, above all, the future citizenry of the country will be the all-important consideration; its repeated efforts for the adoption of a permanent forestry policy looking to the preservation and control of our forests; its continual fight to uphold the constitutional right of a man to work where he pleases, irrespective of membership or non-membership in any organization; for the improvement and inter-relation of our great transportation systems, land, water and rail; for the development of international freight transportation; for improvements in our harbors and inland waterways; for the stabilization of private employment relations; for the reclamation of arid land by irrigation developments; for the equalization of the burdens and responsibilities of all corporations under the law; and for the industrial betterment, health and safety of employees, expert advice being provided on such subjects as employers' liability, workmen's compensation, insurance, accident prevention devices, shop organization for safety and industrial hygiene.

A few characteristic chapters of the Association's efforts for general good are here epitomized:

PLATFORM FOR AMERICA INDUSTRY: In 1920, during the widespread cry for "more business in government and less government in business" the Association brought together fifty-eight prominent business men from all parts of the country, to formulate a Platform for American Industry. No pre-arranged plan was offered or suggested. This committee (including men of all political faiths) evolved a platform, which declared in favor of a budget system for the national government; for the return of the railroads to their private owners and their operation under private ownership; for a constructive policy of selective immigration; for the upbuilding of an American merchant marine; for a broad policy that would encourage and not discourage foreign trade; for the protection of men in their liberty to select and pursue any lawful business or occupation without molestation; for remedial, non-partisan revision of our taxation laws; for the development of a definite and constructive plan of national transportation interrelating railroads, waterways and hard-surfaced roads; for a policy that would prevent the government from entering into competition with its own citizens in any form of business which they can successfully undertake; and for the government to apply to all combinations, the same supervision and regulation which has been applied to business combinations alone. This platform was adopted unanimously at the convention of the Association in 1920 and then was submitted to both the Republican and Democratic national conventions, each of which incorporated in their national platform most of the Association's industrial planks.

In 1924 the Association enlarged its platform committee to one hundred, reshaped its platform and went before both Republican and Democratic conventions again. Then to continue its efforts to arouse interest in the conduct of the national business, it organized a nation-wide campaign to urge people to go to the polls and vote. No effort was made to influence a person in his vote, but to get him to take active interest in his government. The Association devised the slogan:

"Vote as You Please, but—VOTE."

This slogan was sent into all parts of the country and more than 25,000,000 pieces of literature were printed and distributed by the organization. The Association defrayed all the costs and received not a cent in contribution from any outside source. More than one hundred national and local organizations cooperated with the Association in what was the first organized effort to get the whole general public and business interested in national administration. Some of those who received great quantities of material from the Association and participated in the effort were:

The American Legion: The Boy Scouts of America; the Motion Picture Producers and Distributors of America; the Radio Groups, the Elks, Masons, Knights of Columbus, National Automobile Chamber of Commerce, American Bankers Association, Rotary Clubs, Kiwanis, Lion, National Jewish Welfare Board, National Association Credit Men, National Housewives League, International Y. M. C. A.; scores of State organizations; thousands of the members of the Association and various State organizations of the National League of Women Voters.

AMERICAN MERCHANT MARINE: Ever a strong believer and supporter of all institutions that will build up American business and commerce, the Association was early a sponsor of our American Merchant Marine. It favored it year after year. After the war, when we had become more of an international power, the association redoubled its efforts. In 1920 at its convention, it again voiced the need for a national policy for our shipbuilding, which broadly called for a repeal or modification of the laws to

overcome the undue handicaps which had been placed on it. The Association declared that some form of aid must be given our shipping and in May, 1922, the convention unanimously adopted a resolution pledging complete support to the President in his effort to support a merchant marine and expressing approval in general of the Ship Subsidy Bill, declaring for an American built, owned and operated fleet, without handicap.

International Trade Conference: At the outbreak of the War in 1914 the Association issued a bulletin stating that the immediate effects on the commerce and industry of the United States were second only to those on the belligerent nations. The Association issued a call for an international trade conference, sending invitations to commercial and industrial bodies and financial institutions in all countries. An excellent representation was present to consider ways and means to facilitate international transactions interrupted by the war. The principal ones being transportation, credit and exchange. Presentations were made that were invaluable and enabled the group to solve many of the difficult problems confronting them.

Conference of Ambassadors and Ministers on World Trade: After the war, in 1921, the association called a conference of Ambassadors and Ministers of the various countries representated at Washington on world trade. Diplomatic representatives from thirty-eight nations attended, making what was said in official circles to be the largest group of members of the Diplomatic Corps ever held in this country. They presented the economic situation in their respective countries and a special committee made a comprehensive study of all the suggestions offered, adding a valuable contribution to the foreign trade information. The Association is called upon frequently by persons in other countries as the result of this conference.

Industrial Conservation: The Association engaged in an extensive campaign of industrial conservation, designed to promote safety, industrial good-will, and sound economic thinking among the workers.

Reclamation of Arid Lands: Largely through the initiative of the Association, the present marvelous development of our arid sections of the west has been brought about. Years ago, the Association advocated the policy of opening up these lands by means of a system of irrigation and the disposal of them to bona fide settlers under proper restrictions that would safeguard the settlers and the government. Its enterprise in this important field has been very influential in stimulating the government activity with the result that we now have tremendous irrigation projects costing millions of dollars and turning millions of acres of arid lands into veritable gardens.

Department of Commerce: The National Association of Manufacturers can properly claim a very large part of the credit for the establishment of the Department of Commerce and Labor, now separated into the Department of Commerce and the Department of Labor. At the first convention of the Association, held in Chicago, January, 1896, the Association advocated the addition to the President's Cabinet of a Secretary of Manufacturers, conforming somewhat to similar offices of other nations. The Association saw the great benefits that would accrue not only to the manufacturing industry but to the country as a whole, in the government body. From year to year, and between conventions, such a department was urged until in 1903 there was established the combined Department of Commerce and Labor. These two are now separated, but the Association has maintained even closer relations with both, having an advisory committee of manufacturers which is available at all times for conference with the Secretary of Commerce, and having numerous conferences with the Secretary of Labor on matters of public interest.

Taxation: The Association has consistently followed all tax measures for years through its taxation committee and at its convention in 1922, after the widespread complaint of the unjust burdens imposed upon many people by the tax laws, passed a resolution "that we urge upon the Executive and Congress substantial changes in the law which will give more practical recognition to the relation between risk and return, lessen the inequitable burdens and discriminations levied upon selected forms of production and upon small capital actively employed in reproductive industry, simplify, in the light of experience, the form of the law, decentralize its administration and set up practicable regional bodies that may finally determine assessments and adjust collections."

Taking the Tariff Out of Politics: In 1897, Theodore C. Search, President of the Association, in his address to the second annual convention, advocated removal of the tariff from politics, saying:

"The relation of the tariff to the industries of the country is purely a business matter, and that it should ever be tinged with politics is a great misfortune to the manufacturing interests of the nation. I believe the necessity for taking the tariff out of politics and considering it upon a strictly business basis never was more generally recognized than it is at present."

Acting along these lines, the Association, at its convention in 1904 adopted a resolution advocating the establishment of a tariff and Reciprocity Commission as a bureau in the new Department of Commerce and Labor. In 1906, the Association's tariff committee obtained the views of members and the result was an expression of eight to one "that to secure a thoroughly intelligent revision of the tariff laws there should be established a non-partisan tariff commission, not unlike the present Interstate Commerce Commission, with semi-judicial powers, to investigate scientifically the various schedules and from time to time submit their conclusions in the form of recommendations to Congress." At the convention in 1907, a resolution was adopted favoring the creation of this permanent, scientific, non-partisan tariff commission. At every opportunity since, the association has pressed for such a body and in 1921 lent itself effectively to a revision of the tariff laws on a sound basis and in 1922, along with this effort, called a special convention on the American valuation plan; and also made vigorous effort to obtain an elimination of tariff rate-making from politics by giving the commission power to make investigations and also to make changes in rates when necessary.

The Open Shop: Following the vigorous open shop pronouncement of the Anthracite Coal Strike Commission appointed by President Roosevelt, the Association adopted at its convention in 1903, vigorous resolutions espousing the cause of industrial freedom.

Industry's Intelligence Department

Magnus W. Alexander

President, National Industrial Conference Board

INDUSTRIAL and military organization both present many similar problems. The management of industry, like that of a large fighting force, faces the task of efficiently utilizing large numbers of personnel, material and machinery, of effectively coordinating these factors, of fostering discipline, loyalty and enthusiasm among those in the ranks, and of taking an active interest in their welfare. Both industries and armies must constantly adjust their procedure in line with improved technical processes. Organized warfare, however, is much the older of the two, while efforts to coordinate the industrial activities of a nation, and to consider and to treat them in practice as functions of the closely interrelated parts of an organized whole are comparatively recent in origin.

The need for comprehensive data as to the behavior of industry under varying conditions, in good times or bad, made itself increasingly felt with the development of large-scale production in the beginning of the present century. It was more keenly felt when, under the pressure of war demands, output had to be accelerated to an unprecedented degree. Rapidly rising living costs complicated the wage problem. The employment, in many instances, of thousands in the same plant made the former close contact between management and workers impractical, and created new problems of discipline and organization. Comprehensive, accurate information, scientific analysis, definite planning became increasingly essential.

The National Industrial Conference Board, organized in May, 1916, by representatives of a large number of the most important national and state industrial associations, thus was a true product of its time. Its specific purpose was to provide a clearing house for industrial-economic information to make possible the cooperative, systematic approach to all questions bearing on industrial activity. It was a concerted step in the movement to rationalize industry and to substitute science for rule of thumb. While large-scale individual concerns and associations within separate industries had already been doing similar work in their respective limited fields, the Conference Board assumed the task of correlating in its studies data on all industrial activities so as to gain accurate and adequate knowledge of the status and the activity of the nation's industry as a whole, and of its relations to the public and the national interest.

During the ten years of its existence, the Conference Board, with the aid of its large research staff, has striven to furnish to industry such facts as are essential to the intelligent management of a business but are not comprised wholly within the experience of any individual industry, and to interpret these data in the light of the collective experience of all productive groups and of economic research. It seeks to present the fundamental facts with the help of which the industrial executive may lay out his course and formulate his policies. The relative level of wages; their purchasing power in buying the necessities of life; the status of industrial activity as reflected in employment figures, these and many other elements in appraising conditions are no longer left to guesswork. Measured from month to month, they are known factors. Thus, for instance, the studies of the Conference Board show that in 1919 it required 7.5 per cent more workers, 7.8 per cent more power and 23 per cent more management personnel for the same amount of production than it did in 1914, but that in 1923 production had become so much more efficient that it required 25 per cent fewer workers, 13 per cent less power and 18 per cent less management personnel per unit of production than it did before the war. As a result, the purchasing power of the industrial workers' weekly earnings has increased nearly 30 per cent, and the average work week has been reduced by 7 per cent in length since pre-war days. In 1923, each worker in American factories had 16 per cent more primary installed power at his command than in 1914, increasing his productive capacity and thereby making possible higher wage earnings.

The cost of labor during the same period increased along with, but in even greater proportion than production, labor cost per wage-earner per month in 1923 having been 36 per cent greater than in 1914, although production per wage-earner per month in 1923 was only 33 per cent greater. Although 25 per cent fewer workers were required per unit of production in 1923, the total amount of wages paid for an equal amount of production was still 2 per cent higher than in 1914. The cost of management, on the other hand, that is of total salaries paid to management personnel decreased 12 per cent from 1914 to 1923, per unit of production.

When in years gone by, a wage controversy arose the whole issue hinged on the bargaining power, or on the respective determination of employer and employees and their respective strength to sustain an interruption of activity. Neither employer nor employee had any basis of judging what the proper wage should be. Each employer went largely by what others in the same business were paying; he would pay that much but, with an eye on the competitor's prices, be loath to pay more.

Scientific analysis of these problems, such as is constantly being conducted by the research staff of the Conference Board, has resulted in an entirely new orientation for the industrialist, and provides the basis for an entirely new viewpoint. The business man of today knows that poorly-paid workers make poor customers, and that the amount of wages paid has less to do with prices than perhaps had been assumed. He pays on the average 125 per cent higher wages than he paid before the war,

Wage Earnings—United States

Changes Relative to 1914 as Base 100

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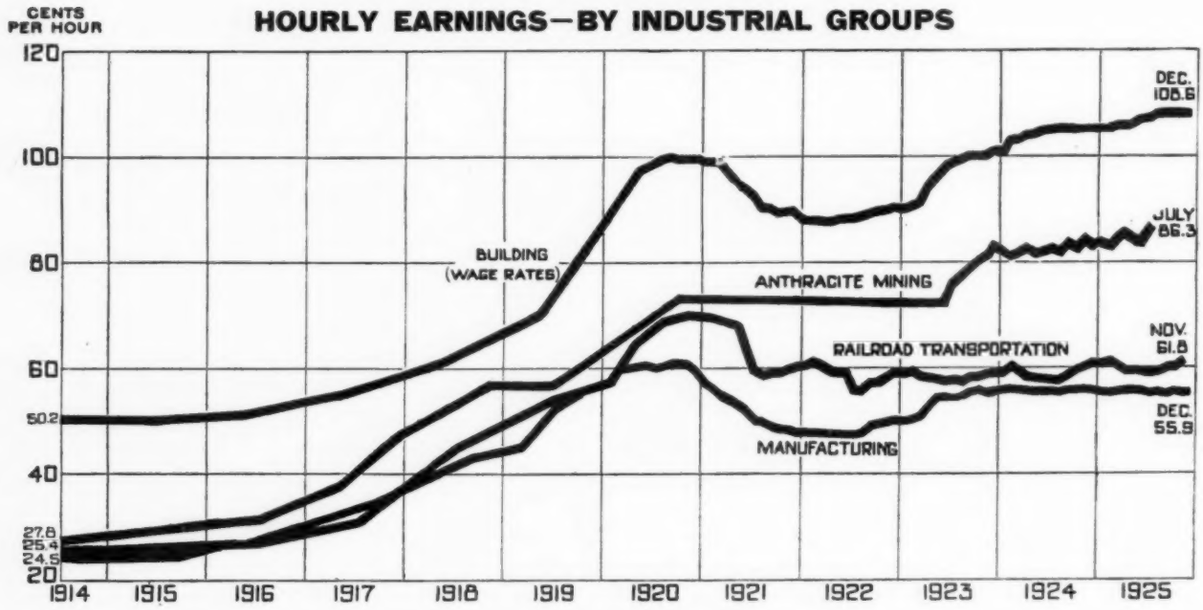

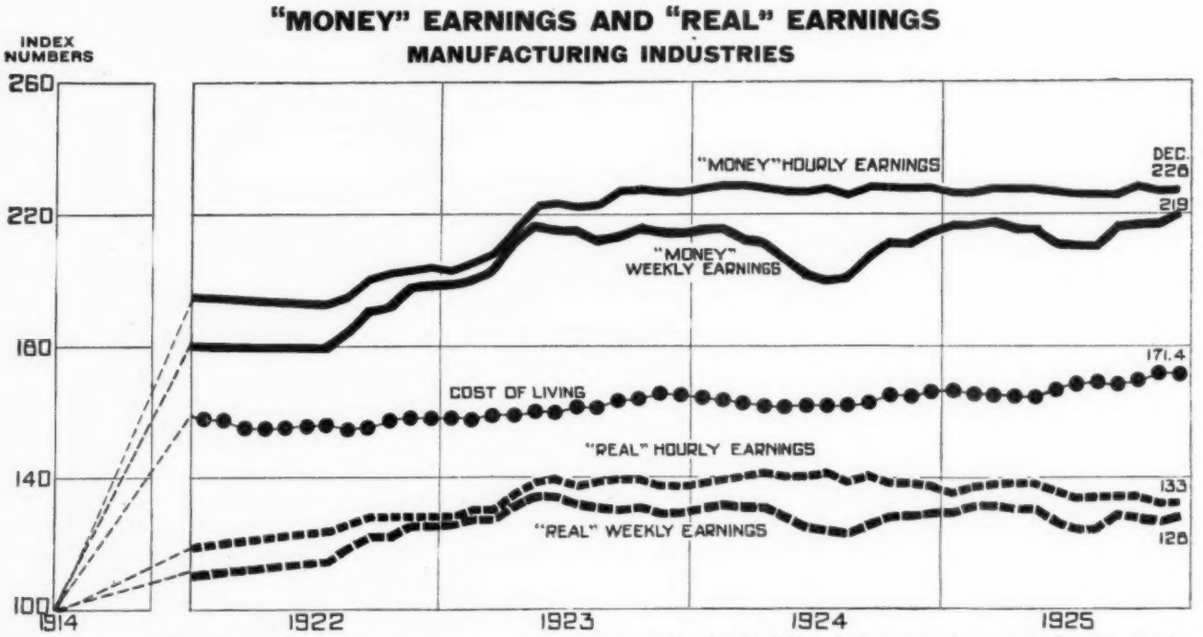

Economic Explanation

This chart shows the wage trend for industrial workers during the war and post-war years to the present time, and also the purchasing power of wages in manufacturing, which is the industrial group comprising the largest number of wage-earners.

In the main the trend is the same for all four groups, all showing advances and moving broadly in the same general direction. Some of the groups have benefited more than others by the advance that has taken place since 1914. Anthracite Mining workers alone retained through the depression period of 1920-1922 the advantage gained during the war. Building workers were far in the lead in actual cents per hour received at the peak in 1920, with wage-earners in Anthracite Mining, Railroad Transportation, and Manufacturing grouped somewhat closer together. During 1923 average hourly wage rates in the Building industry and average hourly earnings in Anthracite Mining moved up considerably and have continued their upward trend with a slower rate of increase in the last two years. Average hourly earnings in Railroad Transportation and in Manufacturing have, however, remained on a fairly even level in the last two and a half years.

Money earnings alone do not express the actutal position of the wage-earner which is more truly determined by ascertaining what the money earnings will buy in terms of the same standard of goods and services at different periods. These "real wages" are obtained by dividing the index of money earnings by the index of Cost of Living.

The chart thus shows the relative economic position of wage-earners in four major industrial groups, and also the economic status of the largest group of wage-earners, as measured by the purchasing power of their money hourly and weekly earnings at different intervals since the beginning of 1922.

Economic Position
United States and the World—1924

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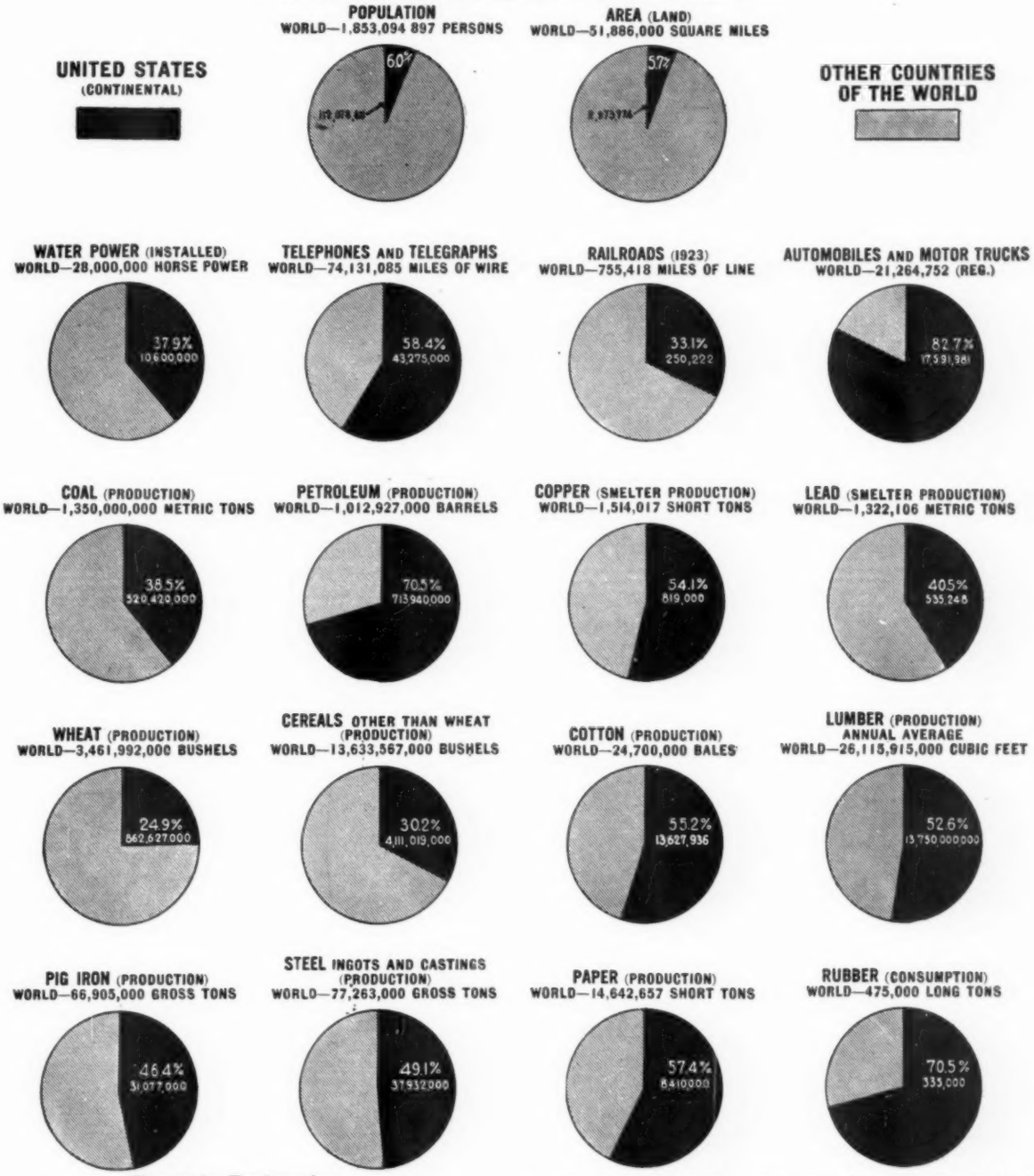


Economic Explanation

This chart shows the relative economic position of the United States in the world during the year 1924.

Although in the year 1924 the United States had only 6 per cent of the total world's population and its land area represented only 5.7 per cent of that of the entire world, our country had developed its resources to a prominent position in world economy.

The significance of the chart lies not so much in the individual percentage figures as in the general picture of the economic status of the United States.

Sources of Information: Unless otherwise noted, the following sources refer to both United States and world figures. "Population" figures are from International Year Book of Agricultural Statistics. "Area" figures are those of the Smithsonian Institution. "Power" from U. S. Geological Survey. "Telephones and Telegraphs" from American Telephone and Telegraph Company. "Railroads" from Bureau of Railway Economics. "Automobiles and Motor Trucks" from National Automobile Chamber of Commerce. "Coal" from U. S. Geological Survey (includes lignite). "Petroleum" from U. S. Bureau of Mines (barrels of 42 gallons). "Copper," "Lead" from American Bureau of Metal Statistics. "Wheat," "Cereals other than Wheat," and "Cotton" from U. S. Department of Agriculture (cotton in terms of bales of 478 lbs. net). "Lumber" from U. S. Forest Service (represents saw timber). "Pig Iron" and "Steel Ingots and Castings" from Iron Trade Review. "Paper" from American Paper and Pulp Association. "Rubber" from the Rubber Association of America.

while prices today are only about 56 per cent higher than before the war. With more and better machinery, the worker today is able to produce, and thus to earn, enough more than he did before the war as to be able to pay the somewhat higher prices and have money left. The machine and increased managerial efficiency make up the difference.

An interesting fact in this connection, revealed in the course of recent studies by the Board is that, while large-scale industry, that is the group of manufacturing plants with an annual output of $1,000,000 or more, is by far the most efficient in the utilization of labor, the medium-sized plants since 1919 have gained in labor utilization efficiency on both the larger and the very small plants. Production per worker in plants with an annual output of from $1,000,000 upwards in 1923 was $1,481 for every $1,000 produced per capita by workers in all plants with less than $1,000,000 annual output. In 1919, however, the per capita production in the larger plants had been $1,590 for every $1,000 produced per worker in all the smaller plants. Thus, while the output of the larger plants in 1919 was 59 per cent larger per worker than the output per worker in the smaller plants, in 1923 it was only 48 per cent larger than the output per worker in the smaller plants, as measured by value of product.

The relative importance and growth of large-scale industry is strikingly reflected in the following data compiled by the Conference Board: While in 1904 plants with an annual output of from $1,000,000 upwards constituted only 1.3 per cent of the total number of all establishments, they employed in that year 26.1 per cent of all wage-earners and produced 38.1 per cent, in value, of all manufactured goods. In 1923, they constituted 5.3 per cent of the total number of all establishments, but they employed 57.1 per cent of all wage-earners, and produced 66.4 per cent in value of all manufactures. In 1919, also, they employed 57.1 per cent of all wage-earners, but produced 68 per cent, in value, of all products, or more than in 1923, with the same percentage of the total number of workers as in 1923.

Large-scale production is a typically American development, and is America's contribution to industrial progress. Having had its rise with the beginning of the present century, it received immense impetus through the war, and the present day finds us the most important industrial country. Our emergence as the leading manufacturing nation has given us a certain place in world economic organization which in turn has affected our environment and reacted upon our industries and people. In the last few years we have been buying goods from other nations to the amount of about $3,755,000,000 a year and in turn have been selling them goods at an average of about $5,035,000,000 a year. An examination of the export trade shows a fairly steady decline in crude materials for manufacturing and of foodstuffs, and a corresponding increase in partly and wholly manufactured goods. Our import trade has been characterized, on the other hand, by a steady increase in crude materials for manufacturing and a corresponding decline in manufactured articles. Thus, our exports of crude materials for manufacturing which averaged well over 60 per cent of all of our exports between 1820 and 1870 have averaged under 30 per cent since 1900, while semi-manufactured and other manufactured goods, which between 1820 and 1870 averaged under 15 per cent of the total have since 1900 comprised about one-half of our total exports. Manufactured goods which from 1820 to 1870 constituted over two-thirds of our total exports have since 1900 averaged under 30 per cent, whereas our crude material imports which prior to 1870 averaged under 20 per cent of the total have since 1900 run at the rate of between 35 and 40 per cent of the total.

Due to our fortunate position in natural resources our competitive position is especially strong. No other country is more nearly self-supporting in minerals and in no other country can the mineral raw materials be delivered as a whole more cheaply than in the United States. We have within our boundaries 38 per cent of the world's installed water power and produce 83 per cent of the world's automobiles; 38 per cent of its coal; 70 per cent of its petroleum; 54 per cent of its copper; 40 per cent of its lead; 46 per cent of its pig iron; 49 per cent of its steel ingots and castings; 57 per cent of its paper; 53 per cent of its lumber; 55 per cent of its cotton; 25 per cent of its wheat; and 30 per cent of its cereals, other than wheat. Yet, we are as a nation dependent upon other nations for certain important raw materials or for products essential in the manufacture of goods in which we excel. This dependence on other countries for certain essential materials in the face of attempts by certain of the foreign nations to control the supply and hence the price of these, has resulted in a head-on collision between economies and polities and confronted certain of our industries with a most serious situation. If the right is accorded to any nation to monopolize either temporarily or permanently the output of a commodity which is dominantly produced within its boundaries, and on which other nations are dependent for their comfort and standard of living, then we must face a situation of economic warfare in which every nation must inevitably suffer and which can bring no satisfactory result to any. The controls of Egyptian cotton, of coffee, rubber, potash, nitrates, and other commodities have very properly brought objection from the United States Government as a principle that is wrong both in economics and in polities and out of which no good can come.

Reference should also be made to the greatly improved standard of living in the United States, and the better position of the American people as compared with that of other nations. Not only is the per capita amount of national income higher, but despite our reputation as a wasteful and free-spending people, savings are considerably higher in the United States than in other countries. Indicative of the relative position of the American wage-earner in comparison with the wage-earners of other countries may be noted the following figures based on studies by the International Labor Organization at Geneva, Switzerland. These studies show that, if we place the purchasing value of wage-earners' incomes relative to the cost of food and shelter in Philadelphia, as typical of the United States, at 100, the position of other countries is: Ottawa (Can.) 83, Sidney (Australia) 77, Copenhagen (Denmark) 72, Oslo (Norway) 58, London (England) 56, Amsterdam (Holland) 49, Stockholm (Sweden) 49, Berlin (Germany) 40, Prague (Czecho-Slovakia) 33,

Brussels (Belgium) 33, Vienna (Austria) 29, Milan (Italy) 28, Warsaw (Poland) 26, Tallinn (Esthonia) 24. Thus at the beginning of 1926, the American wage-earner was, with the exception of the wage-earner in Denmark, from 40 per cent to over 75 per cent better off than the average European wage-earner. Whereas the orthodox economists have held that the danger to the standard of living of any people came from low-paid workers, American industrial organization has shown that high wages coupled with high productivity and efficient factory organization may result in production of goods at prices capable of meeting the competition of pauper labor. Realization of this fact is bringing European managers to the United States in large numbers to study our methods.

Twentieth century civilization is industrialized to such an extent that there are few major public questions that do not have a bearing on, or are not affected by industry. A cursory examination of the subjects of study on which the Conference Board is and has been engaged indicates the broad character of its vision and activities. Besides the continuous studies of wages, working hours and employment, of living costs and of the multitude of plans, methods and experiments belonging to the realm of industrial relations, there are, for instance, investigations of taxation, immigration, of trade association activities and of competitive practices and their regulation, of the Inter-Ally debts and taxation in the debtor countries, and of the agricultural situation and problem. It may be a far cry for American industry to concern itself with the amount of fertilizer used per acre on the farms in Holland, but the item has its definite relation to American agricultural conditions and thereby, to American industrial prosperity, and hence is accounted for in the Board's agricultural study.

The Conference Board came into being as a research organization for American industry ten years ago because the need for it was pressing. The value of its work necessarily increases as time goes on and its fund of information grows. It is a laboratory for the finding of facts upon which rests the science of industrial organization and methods, the practice of which involves directly the welfare of the more than 12,000,000 men and women engaged in industry, of their families, and indirectly, the prosperity of the nation. The Board's findings, which are embodied in published reports, are a continuous medium for clarifying public thought on industrial-economic questions, and a constant source of information for statesmen, educators and students. They frequently figure in Congressional debate, as during the recent deliberations on farm relief legislation. The Board's recent Inter-Ally debt study served as a valued handbook for the members of the American Debt Funding Commission during recent debt settlement negotiations. The major portion of newspaper editorial comment on taxation problems during the past two years or more may be said to have been based on or inspired by the Board's taxation studies.

Among the important recent publications of the Board are: Wages and Hours in the United States; Cost of Living in the United States, 1914-1926; Trade Associations: Their Economic Significance and Legal Status; Public Regulation of Competitive Practices; Medical Care of Industrial Workers; Industrial Pensions in the United States; The Cost of Government in the United States; The Inter-Ally Debts and the United States; The Agricultural Problem in the United States. In preparation, or soon to be published are reports on the following subjects: Cost of Living in Foreign Countries; Experience With Systems of Wage Payment; Experience With Employee Representation; The Industrial Combination Movement.

The work of the Conference Board aims to cover both the changing facts and trends of industrial development as well as the broader economic principles underlying industrial evolution, and to contribute to the clearer understanding of the problems of industry and their solution. During the ten years of its existence the Conference Board has gone far in providing a scientific basis for the appraisal of industrial-economic problems. The foundation work has been done; the days of further building still lie ahead.

Four Months Added to Army Industrial College Course

THE sixth course of the Army Industrial College opened September 1st in the college headquarters, Washington, D. C. Previous courses have been for five months with two classes for each year, each of thirty student officers. The present course has been increased to the full academic year of nine months and authorization has been granted by the Secretary of War for the attendance of forty student officers.

The four months added to the length of the course will permit of introduction of industrial studies similar to those of the Harvard School of Business Administration. These studies have been developed and coordinated for Army procurement purposes by Army officers who have graduated from the Harvard School of Business Administration. Enrollments to date for the coming course include 33 supply officers of the Army, one Navy officer and one Marine Corps officer.

The following officers are enrolled for the present course:

Lieutenant Colonels: John A. Wagner, Q. M. C.; William O. Smith, Q. M. C.; Odiorne H. Sampson, Q. M. C.

Majors: Robert P. Howell, C. of E.; W. Lee Hart, M. C.; Roy C. Heflebower, M. C.; Robert H. Duenner, M. C.; Archie W. Barry, A. C.; John T. Harris, Q. M. C.; John Mather, Ord. Dept.; Roy H. Coles, S. C.; Donald Armstrong, Ord. Dept.; George M. Halloran, C. W. S.; Henry W. Harms, A. C.; Reiff H. Hannum, Ord. Dept.; George Luberoff, Q. M. C.; Eugene O. Hopkins, F. D.; Elroy S. J. Irvine, C. of E.

Captains: Edwin M. Scott, Q. M. C.; Dorris A. Hanes, Q. M. C.; Howard McC. Yost, C. of E.; Calvert H. Arnold, S. C.; Olaf P. Winningstad, Ord. Dept.; Read Wipprecht, Ord. Dept.; Frederick E. Hagen, Q. M. C.; Randolph J. Hernandez, Q. M. C.

First Lieutenants: Herman U. Wagner, Ord. Dept.; Clyde H. Morgan, Ord. Dept.; Henry M. Black, C. W. S.; John Y. York, Jr., A. C.; James B. Carroll, A. C., and Byron A. Falk, S. C.

The American Society for Steel Treating

DELVERS in the histories of the several scores of important technical organizations in the world may search far and long and they will not find anything as interesting or as dramatic as the story of the rapid growth of the American Society for Steel Treating.

In 1914, W. P. Woodside, manager of the Detroit branch of the Crucible Steel Company, and formerly a toolsmith and tool hardener for the Cadillac Motor Company, conceived the idea of bringing together outside of working hours the technically trained executives and the practical men of the hardening room in such a way that they could get acquainted, compare notes and thereby learn from one another. With this purpose in mind, Mr. Woodside invited about twenty men from the shop to be his guests at a dinner at the Fellowcraft Club, Detroit, on March 3, 1914. At this meeting Mr. Fred O'Mara, of the Sheldon School of Business Building, gave an address impressing upon the men the advantage of educating themselves as to the scientific end of their work and how, if they associated themselves with the chemists and metallurgists of their plants, they could obtain considerable theory of commercial value.

Mr. Woodside's guests were so pleased with their meeting that a second was arranged for the following Saturday night. At this time the men drew up a rough draft of rules and regulations and formally organized a little club to be known as the Steel Treaters' Society. This organization moved along fairly well for about four years and during this period, a number of metallurgists joined its ranks. The work of the society having attracted attention outside of Detroit, a reorganization on a national basis was effected and a new name, The Steel Treating Research Society, was adopted. Chapters were organized in Chicago, Hartford, Conn., and Indianapolis, with the Detroit chapter functioning as the parent organization.

In the meantime, however, another local society interested in heat treating had sprung up in Chicago in 1917. This organization conducted itself as a local body and continued on this basis for several months after the Chicago chapter of the Steel Treating Research Society was established. However, on September 18, 1918, just after the local club was started, a national society was founded under the leadership of T. E. Barker, then production engineer of the Miehle Printing Press and Manufacturing Company. The new society took the name of The American Steel Treaters' Society. Its organization was prompted by a desire on the part of a group of enthusiastic men to provide for the heat treating and associated crafts of the country an organization which would function as a national clearing house for all that might contribute to the promotion of the science of heat treatment of steel.

It was at this point in the American steelmaking industry that alloy steels were in the process of development. Furthermore, it was becoming more and more evident that if steel treating in the hands of the user was to keep pace with steelmaking in the hands of the scientifically equipped steel mill metallurgists, a machinery of national scope must be established for the transmission of new discoveries, results of isolated experiments, and knowledge of the application of newly developed alloys. The exigencies of war also made it extremely desirable that all information pertaining to the art of heat treating be made immediately available to all who could make use of it in a common cause, namely, to win the war.

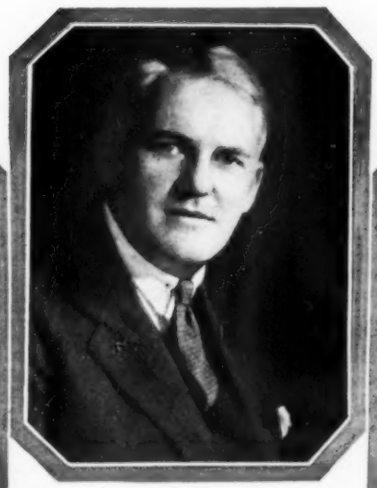
War Needs Spurred Activity

Although the war ended two months after organization of the new society, the conditions then prevailing and the keen appreciation of the need for definite knowledge of how to handle many of the steels prescribed for war machinery and equipment, were factors in spurring the society to far reaching activities. Cessation of the war did not remove the need for the society, consequently the organization program went ahead steadily. Regardless of whether the success of the society should be attributed to opportuneness or to those responsible for its inspiration and guidance, the result was a phenomenal growth combined with financial strength.

Officers elected to guide the American Steel Treaters' Society were: President, T. E. Barker, production engineer, Miehle Printing Press and Manufacturing Company; first vice-president, A. F. Boissoneau, assistant manager, A. Finkl & Sons Company, Chicago; second vice-president, E. J. Janitzky, metallurgical engineer, Illinois Steel Company, South Chicago, Ill.; and secretary-treasurer, A. G. Henry, metallurgist, Illinois Tool Works, Chicago. These officers were of a progressive type and were quick to adopt policies which were destined to put the society in the foreground with other leading technical organizations of the country. Just one month after the new society was organized, the first issue of the *Journal* was published and contained 60 pages of editorial matter devoted to heat treatment problems and society news, in addition to several pages of advertising.

Affairs of the society, including the editing and publishing of the *Journal*, expanded so rapidly that it soon became imparative to secure a business manager. Consequently the books of the society were thrown open to those interested in securing the position, thus affording an opportunity to judge the future of the organization. Following a thorough consideration of the proposition, William H. Eisenman, superintendent of schools in a Chicago suburb, offered to place his lot with the board of directors and to endeavor to place the society in the front rank with other technical organizations. As a result, Mr. Eisenman was appointed business manager, and assumed his duties on December 1, 1918.

American Society for Steel Treating
Officers, 1926

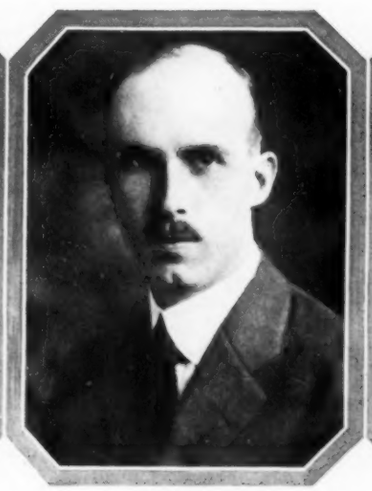


R. M. BIRD
President

W. S. BIDLE
Member of Board of Directors

F. G. HUGHES
Member of Board of Directors

W. H. EISENMAN
Secretary



J. P. HARPER
Vice-President

DR. ZAY JEFFRIES
Treasurer

First Office in Shop

At this time chapters of the society numbered just one and the total membership was in the neighborhood of 200. His problem, therefore, was to make a national society from a local chapter. In addition, he was to handle office correspondence, edit the *Journal* and increase the advertising in the publication. To curtail expenses, the office was located in the corner of a machine shop and adjacent to a hobbing machine.

After a month or two spent in familiarizing himself with the work, Mr. Eisenman started out on a tour of organization, going first to Cleveland where a chapter was installed, the first chairman of which was W. S. Bidle, who later became president of the American Society for Steel Treating. From Cleveland the new business manager went to Pittsburg where the third chapter was organized. After this came chapters in Milwaukee, Philadelphia, Cincinnati, Buffalo, Rochester and New York, so that by the time summer vacation arrived, the number of chapters had been increased from one to nine and the membership from 200 to 700.

In the fall of 1918, A. G. Henry, national secretary and treasurer of the society had an opportunity to observe the exposition of the American Foundrymen's Association in the Milwaukee Public Auditorium. This suggested to Mr. Henry the idea of an exhibition of heat treating appliances and heat treated products in connection with the first national convention which was to be held in Chicago September 23-27, 1919. The plan was proposed to the national officers and board of directors and met with approval. Consequently, Mr. Henry was appointed chairman of the exhibit committee and authorized to make all necessary arrangements.

Prospective exhibitors were approached on the subject and seemed eager for the opportunity to display their products, consequently the Seventh Regiment Armory was engaged for the week of the convention. Over fifty manufacturers of steel treating products and equipment were represented at this first exposition and the project was successful in every sense of the word.

Previous to the holding of the first annual convention of the American Steel Treaters' Society, Lt. Col. A. E. White, Ord. Res., U. S. A., at that time on leave of absence from the University of Michigan and an officer in the Ordnance Department, U. S. Army, had a conviction that for the best interests of the iron and steel industry, the two heat treating societies should be united. With this purpose in mind he was successful in arranging at Battle Creek, Mich., a conference between T. E. Barker, president of the American Steel Treaters' Society, and John F. Keller, president of the Steel Treating Research Society. Both of these gentlemen agreed with Colonel White that the purpose of their organizations were so similar that greater good might be accomplished were it possible for the two to operate as one.

Rival Societies Plan Merger

As a result of this conference each of the presidents appointed three representatives from their respective societies to meet in Chicago during the week of the convention to investigate and work out means for an amalgamation. This committee met in Chicago and for three days labored continuously getting a constitution in shape and ironing out some of the various difficulties as to the method of procedure. Being a member of neither society, Colonel White acted as chairman of the committee. The plan finally adopted was to be submitted to the directors and membership of both societies for approval.

Plans had been made for holding the 1920 convention and exposition of the American Steel Treaters' Society in Philadelphia, therefore it was proposed that the two steel treating societies hold their conventions jointly with the hope that by that time a definite plan for the amalgamation of the two societies would be completed. This plan met with the approval of the Detroit society. The Chicago society in the meantime had continued its active work of organizing new chapters and at the time of the opening of the Philadelphia convention the number of active chapters had been increased from nine to twenty.

In February, 1920, a mail vote was conducted by both societies in which the memberships were overwhelmingly in favor of the amalgamation. Consequently, the various necessary arrangements for the joining of the two organizations were made and the American Steel Treaters' Society and the Steel Treating Research Society were merged into the American Society for Steel Treating at the opening session of the 1920 convention on September 14th. At the time of the amalgamation officers of the American Steel Treaters' Society were: T. E. Barker, president; E. J. Janitzky, first vice-president; D. K. Bullens, second vice-president; W. H. Eisenman, executive secretary; and A. F. Boissoneau, treasurer. Officers of the Steel Treating Research Society were: John F. Keller, president; L. A. Danse, vice-president; and L. S. Carrick, secretary-treasurer.

When the amalgamation of the two societies became a certainty early in 1920, a nominating committee was appointed to choose officers for the American Society for Steel Treating. At the Philadelphia convention, the nominees of this committee were elected and were as follows: Lt. Col. A. E. White, Ord. Res., U. S. A., professor of chemical engineering, University of Michigan, Ann Arbor, Mich., president; T. E. Barker, production engineer, Miehle Printing Press and Manufacturing Company, Chicago, and T. D. Lynch, research engineer, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., vice-presidents; W. H. Eisenman, 208 N. Wabash Avenue, Chicago, secretary; W. S. Bidle, president, W. S. Bidle Company, Cleveland, treasurer.

With the amalgamation complete, the new society had a chapter roll of 27 and a membership of approximately 2,000. The convention and exposition both were held in the Commercial Museum, Philadelphia, September 14-18, about 10,000 attending. The exposition was the second of its kind to be held and again proved the enthusiasm of the various manufacturers of heat treating equipment and products, inasmuch as they subscribed liberally for space. Exhibits occupied a floor area of 9,000 square feet, as compared with 6,000 square feet at Chicago the previous year.

It was agreed during the amalgamation proceedings that the American Society for Steel Treating should be incorporated under the laws of Ohio and the national office moved to Cleveland. On December 1, 1920, the secretary moved his office from Chicago to 4600 Prospect Avenue, Cleveland, which location the society still retains. At the time this change was effected the publication of the society was changed from the *Journal* to the *Transactions*.

The next year found the convention and exhibition held at the state fair grounds in Indianapolis, where in spite of the general industrial depression, the number of exhibitors was satisfactory. Exposition floor space totaled 12,000 square feet, an increase of 3,000 square feet over 1920. The attendance was approximately 10,000. At this convention, which was held September 19-24, the following officers were selected to carry on the work of the society during 1921-22: Frank P. Gilligan, secretary-treasurer, Henry Souther Engineering Company, Hartford, Conn., president; F. C. Lau, 242 South Kenilworth Avenue, Oak Park, Ill., first vice-president; R. J. Allen, metallurgist, Rolls-Royce Company of America, Springfield, Mass., second vice-president; W. H. Eisenman, 4600 Prospect Avenue, Cleveland, secretary; and J. V. Emmons, metallurgist, Cleveland Twist Drill Company, Cleveland, treasurer.

When the society established its headquarters in Cleveland it was considered expedient to employ a part-time editor of *Transactions*, the publication having grown to such proportions that the secretary could no longer handle it along with his other duties. In May, 1922, Ray T. Bayless became editor, and since that time has remained in that capacity and has done much to increase the value of the publication.

Shortly after the death in the early part of 1922 of Dr. Henry Marion Howe, an honorary member of the society, the board of directors established the Henry Marion Howe Medal and set aside a sum of money to guarantee its perpetuation. The establishment of this medal, which is of gold, was a tribute to the exceptional contributions to the science of metallurgy made by Dr. Howe and was to "be awarded annually to the author of the paper which shall be judged to be of the highest merit. All papers in order to be considered must be published originally in the *Transactions* of the society during the twelve months ending August 1st of the year in which the medal is awarded."

A. S. S. T. Expositions Grow in Size and Importance

The annual meeting of the society in 1922 was held in the General Motors building at Detroit, October 2-5, and was by far the largest which had been held. In addition, the exposition was the largest the society had conducted, covering 20,000 square feet of floor space, an increase of 8,000 square feet over the 1921 show at Indianapolis. Approximately 20,000 people attended. At this convention the society dedicated at Wyandotte, Mich., a bronze tablet to the memory of William Kelly, who is claimed to be the first and original producer of steel in the United States by means of a pneumatic converter. The tablet was erected by the Detroit chapter of the society and is placed on the outside wall of the public library, which now stands on the site of the Wyandotte Iron Works where in 1864 William Kelly's first tilting converter operated.

In November, 1922, the American Society for Steel Treating, through its board of directors, honored W. P. Woodside, founder of the Steel Treating Research Society, and T. E. Barker, founder of the American Steel Treaters' Society, with founder memberships in the society. The establishment of these memberships was in recognition of the work these two men did in laying a firm foundation upon which the new structure was erected.

Pittsburgh Convention Sets a Record

In 1923 the annual convention and exposition was held at Motor Square Garden, Pittsburgh, October 8-12. With an attendance of approximately 55,000, all previous attendance records were eclipsed. Exposition space totaled 30,000 square feet, an increase of 50 per cent over the Detroit show. At this convention the Henry Marion Howe Medal for 1922 was awarded to E. J. Janitzky, metallurgical engineer, Illinois Steel Company, South Chicago, Ill., for his paper, "Influence of Mass in Heat Treatment." The medal was not awarded for 1923.

Officers chosen to direct the society in 1923-24 were: George K. Burgess, director, Bureau of Standards, Washington, president; W. S. Bidle, president, W. S. Bidle Company, Cleveland, first vice-president; R. M. Bird, engineer of tests, Bethlehem Steel Company, Bethlehem, Pa., second vice-president; W. H. Eisenman, 4600 Prospect Avenue, Cleveland, secretary; and Zay Jeffries, research bureau, Aluminum Company of America, Cleveland, treasurer.

As the society grew, it extended its activities and services to members. Many committees were in operation, but their progress was impeded by the fact that the work was not centralized. Consequently, early in 1924, J. E. Donnellan was engaged as secretary to various national committees, his duties being to assist in getting material together and to relieve the committee chairmen and members. The new arrangement has worked out most satisfactorily.

Feeling that numerous changes in the constitution were advisable in order that the instrument would more nearly comply with the laws of the principal states and especially the laws of Ohio, under which the society is incorporated, a committee had been active during 1923 in preparing a new draft. The proposed changes were discussed at the Pittsburgh meeting and numerous modifications suggested. Early in 1924 the revised draft was placed before the membership and adopted. Under the new constitution the society has but one vice-president instead of first and second vice-presidents. Probably the most important change, however, was the method of selecting the nominating committee. Previously, this committee was composed of five members who met in the spring to select the candidates for offices. Officers were elected by mail vote and assumed their positions at the annual convention in the fall. Under the new constitution, however, the nominating committee is composed of one member of each chapter, and meets at the fall convention.

One record for which the society can be justly proud is its attendance record at national conventions. About half of the membership registers each year, a peak of 53.6 per cent having been reached at the Pittsburgh convention in 1923. It is doubtful if any other technical society of its size can boast of such a record. Between 250 and 300 chapter meetings are held each year with a total attendance in the neighborhood of 28,000. About 400 members of the society are serving on various technical and administrative committees in the preparation of recommended practices, reports, professional papers, meetings and the dissemination of literature for the advancement of the metallurgical profession and the steel industry. Of this number about one-half are on national committees and one-half on local committees.

Ordnance News in Pictures

General Williams Congratulated

Maj. Gen. C. C. Williams, Chief of Ordnance, U. S. A., was the recipient of congratulations on July 16, 1926, when he began his third term as head of the Ordnance Department.

Tractor Tackles Tank in Test

During a recent training camp of Reserve Officers of the Sixth Corps Area, gathered for study of tanks and artillery tractors, a sham battle was staged as part of the program. The standard "Caterpillar" Sixty, challenging the tank, proved itself equally nimble in scrambling through brush and over the top.

Leap Frog a la Tank

What happens when tank meets tank is shown by this photograph taken during a sham battle held by the 312th Infantry, 78th Division, New Jersey's famous World War Regiment. The battle was conducted by Reserve Officers of the 312th during their training camp at Staten Island, N. Y., July, 1926.

THE RESERVE OFFICERS' ASSOCIATION OF THE UNITED STATES

Brig. Gen. John Ross Delafield, Ord. Res., U. S. A.

ALMOST at the beginning of the development of the Organized Reserves in 1922 those who had it in charge for the Regular Army saw that much must be done for it which the Regular Army was not able to do. Its success required the support of the people at large. To obtain this, it was necessary as far as possible to make the general plan of the National Defense Act known throughout the country. There being no pressing emergency which would bring the Act to universal attention, the best alternative was to organize as large a body of men as possible to accomplish this and to secure the support of the people for the plan. Such an activity is clearly outside the functions of the Regular Army. At first it was thought that a civilian organization made up of Regular Army, National Guard, and Reserve Officers, might best accomplish this, but experience soon showed that the limitations upon the activities of Regular Army Officers, and an erroneous prejudice as to the National Guard, hindered them in such work, and made organizations of this character ineffective for this purpose. The impression that Regular Army Officers and National Guardsmen were seeking their own professional advancement had also to be overcome.

BRIG. GEN. JOHN ROSS DELAFIELD, ORD. RES., U. S. A.
Former President, Reserve Officers' Association of the United States.

Because of this experience, and the needs, a committee of Reserve Officers was formed during the spring and summer of 1922, which, after formulating a general plan at the suggestion and with the approval of General Pershing, and other leading officers of the War Department, called a convention of Reserve Officers to meet in Washington during October. This convention was attended by several hundred Reserve Officers, representing most of the states of the Union. Its sessions lasted three days and were addressed by the principal officers of the War Department, and of the Army. There were many earnest debates in which fundamental questions of National Defense were considered. General Pershing said of this convention:

"I consider this gathering perhaps one of the most important from a military point of view that has assembled in Washington or anywhere else within the confines of the country within my time."

Here was formed the Reserve Officers' Association of the United States. It has a National Association divided into State Departments, and these again into local chapters. The membership of the chapters is again generally subdivided into squads, each with its leader. Quick contact is thus maintained by telephone or otherwise and effective and prompt action secured.

The Constitution drawn up and adopted by the Convention stated that the sole object of the Association was:

"The object of this Association shall be to support and assist in the development and execution of a military policy for the United States which shall provide adequate National Defense."

This is generally interpreted to apply to the Army and not to include the Navy. For the reasons already given membership is confined to Reserve Officers.

The Association has grown rapidly. The Reserve Officers in the various states have organized in quick succession and applied for and obtained State Department charters, and these were followed by the organization of Local

Chapters so that now there are forty-seven State Departments and four hundred and ten Local Chapters; also chapters in the Philippine Islands and Porto Rico with a total paid up membership of about 13,000 officers.

The work of the Association has been actively carried forward by the coordinated effort of the Reserve Officers in their many chapters. These are guided by letters and circulars sent out from National Headquarters in Washington, D. C., and by a voluminous correspondence. *The Reserve Officer,* a monthly publication issued by the Association, serves a similar purpose and disseminates news of the Reserves. The newspapers in many parts of the country have been encouraged to print many articles and editorials on subjects of National Defense and explaining the National Defense Act. The subject has been discussed throughout the country at many public meetings, some of which have been organized for the purpose. Popular interest has grown to such an extent that the Association and its friends have been able to secure increasing appropriations from Congress each year for the training and organization of the Reserves. These were only $250,000 in 1922-1923, and grew gradually to $3,721,300 for the fiscal year 1926-1927. The Reserve Officers have presented to the War Department through this organization many recommendations for the betterment of the Organized Reserves, of which most have been put into effect. The National Officers have kept in constant contact with the principal officers of the War Department and have given aid as far as possible. In fact, the Secretary is and has been on active duty with the General Staff continuously since his first appointment in October 1923. Help has also been given the officers of the Regular Army in their work for the units of the Organized Reserves in many parts of the country. Organization morale has been strengthened, troop schools have been encouraged, correspondence courses recommended, etc. In fact, this has been so much the case that Regular Army officers often state that wherever there is a strong chapter of the Reserve Officers Association, there the units of the Organized Reserves are also active. Aid has been given the National Guard in various ways, particularly in getting through bills in State Legislatures, by which essential appropriations were made for the National Guard and by assisting in securing the passage of other bills. Especial effort has also been made to encourage and help the Reserve Officers Training Corps in the colleges. The effort in this direction is to stimulate the interest of the students so that they continue with the course throughout the four years and take their commissions in the Reserve at graduation. The Association has also helped with the Citizens Military Training Camps by encouraging its members to assist the civilian aids to the Secretary of War and to accept appointments in their organizations, also to volunteer to assist in training the C. M. T. C. candidates.

A general view of the Organized Reserves through the country shows that, however great and wonderful their progress in organization and training and morale has been in the last four years, what remains to be accomplished is vastly more than what has already been done. The morale and activity of Reserve Officers themselves and their units must be increased, and officers not suited to the work eliminated, certain policies and regulations of the War Department should be changed, the knowledge and interest of the public should be greatly increased.

The Reserve Officers' Association has shown itself successful in this important work for national defense during the last four years. As its success, however, depends on arousing and holding popular understanding and interest, it must depend on the numbers and activity of its members. Most Reserve Officers who are active become members of this Association. It should be strengthened and encouraged.

Col. Ralph Crews

COL. RALPH CREWS, of New York City, who served as counsel of the Army Ordnance Association since its organization in 1919, died September 6, 1926, when an automobile in which he was riding skidded and turned over in East Moriches, L. I., N. Y.

Entering the Army as a Major, Ord. Dept., in 1917, Colonel Crews rendered preeminent service to the Department and the Association.

Born at Mt. Vernon, Ill., in 1856, he was educated in the Hyde Park School, Chicago, and in the Chicago College of Law, receiving his degree in 1897. He practiced law in Chicago until 1917, when he entered the Ordnance Department. Following the termination of the War in 1919, he resumed the practice of law as a member of the firm of Shearman and Sterling, 55 Wall Street, New York City.

When steps were taken in 1919 to organize the Army Ordnance Association Colonel Crews gave unsparingly of his time and attention, and when the Association was founded he became its counsel. He served in this capacity until his death. In addition to his activities as a member of the Association, he was also a director of the National City Company; the Metropolitan Trust Company; Old Ben Coal Company; Austin Machinery Company, Chicago; Brokaw and Company; Thomas G. Logan, Inc.; and the United States Fidelity and Guaranty Company. He was also attorney for a number of large corporations.

He is survived by his widow who was Miss Elizabeth Stuart Sherman, and three children, Ralph, Jr., Mary A., and Elizabeth R. Crews.

Instruments for Making Ballistic Determinations and Some Results Obtained at Aberdeen Proving Ground

Maj. Arthur W. Ford, Ord. Dept., U. S. A.

Part I—Muzzle Velocity Measurements

THAT branch of applied mechanics which treats of the motion of projectiles, known as ballistics, has interested some of the greatest mathematicians and physicists of the past and they have made important contributions to the science in the form of formulae and methods for conducting ballistic computations and analyses, and also, in the design and improvement of instruments for making ballistic determinations. Exterior ballistics treats of the motion of projectiles in free air and is the basis of the art of gunnery; it, therefore, is of interest and importance to every rifleman and artilleryman. Interior ballistics treats of the motion of the projectile while in the gun and with the physical and chemical phenomena which cause and attend this motion.

Theory should be tested whenever possible by practical experiments in order to eliminate errors and correct hypotheses. For these practical experiments and tests certain instruments are necessary. These instruments are of a type which are of an essentially special nature, concerned as they are with obtaining records of phenomena which occur at extremely high pressures or high velocities and often must be recorded in a very small fraction of a second. Various instruments have been employed to obtain such features as: the velocity of projectiles, the powder gas pressures in a gun as a function of the distance the projectile has moved or of the time elapsed, the force of the blast caused by an explosion, the resistance function of projectiles moving in free air, the trajectories of projectiles and of bombs, and many equally interesting and difficult determinations.

Le Boulengé Chronograph

One of the most extensively used instruments for measuring the velocity of projectiles in air is one invented by Captain Le Boulengé of the Belgian Artillery, called in America the Boulengé Chronograph.[1] It was modified and improved by Captain Bréger of the French Artillery and has been further improved in America. The instrument is designed to measure the time T which elapses between the successive ruptures of two electric circuits. For this purpose, in front of the gun are placed two vertical screens upon each of which is stretched a wire carrying one of the two circuits, (Fig. 1). In passing through the screens, the projectile successively breaks both of the circuits connected with the instrument. The distance D between the screens being known from actual measurement, the mean velocity of the projectile during the time T is:

$$V = \frac{D}{T}$$

The best working conditions result when T is between ten and twelve hundredths of a second, but on the other hand the instrument can be used to measure accurately much shorter intervals.

The instrument (Fig. 2) consists of a vertical column A to which are attached two electro-magnets. That on the right, B, is magnetized by the current through the first screen and supports an armature, E, called the "chronometer"; that on the left, C, is magnetized by the current through the second screen and supports an armature, G, called the "registrar."

Fig. 1. Velocity Screens in place for Le Boulengé Chronograph Firing with 75-mm. Gun.

The chronometer is a long cylindrical brass tube, having in its upper end a soft iron core and in its lower end a steel bob. The brass tube carries on its exterior a close-fitting zinc tube called the recorder, F.

The registrar of the same weight as the chronometer, is also a brass tube having a soft iron core at the top and a steel bob at the bottom.

The cores of the two electro-magnets and the soft-iron armatures are terminated by cones which touch in slightly rounded points. This arrangement permits the armatures to hang vertically under the action of their weight.

1. Description and Instructions for the use of the Boulengé Chronograph. Ordnance Pamphlet No. 1682.

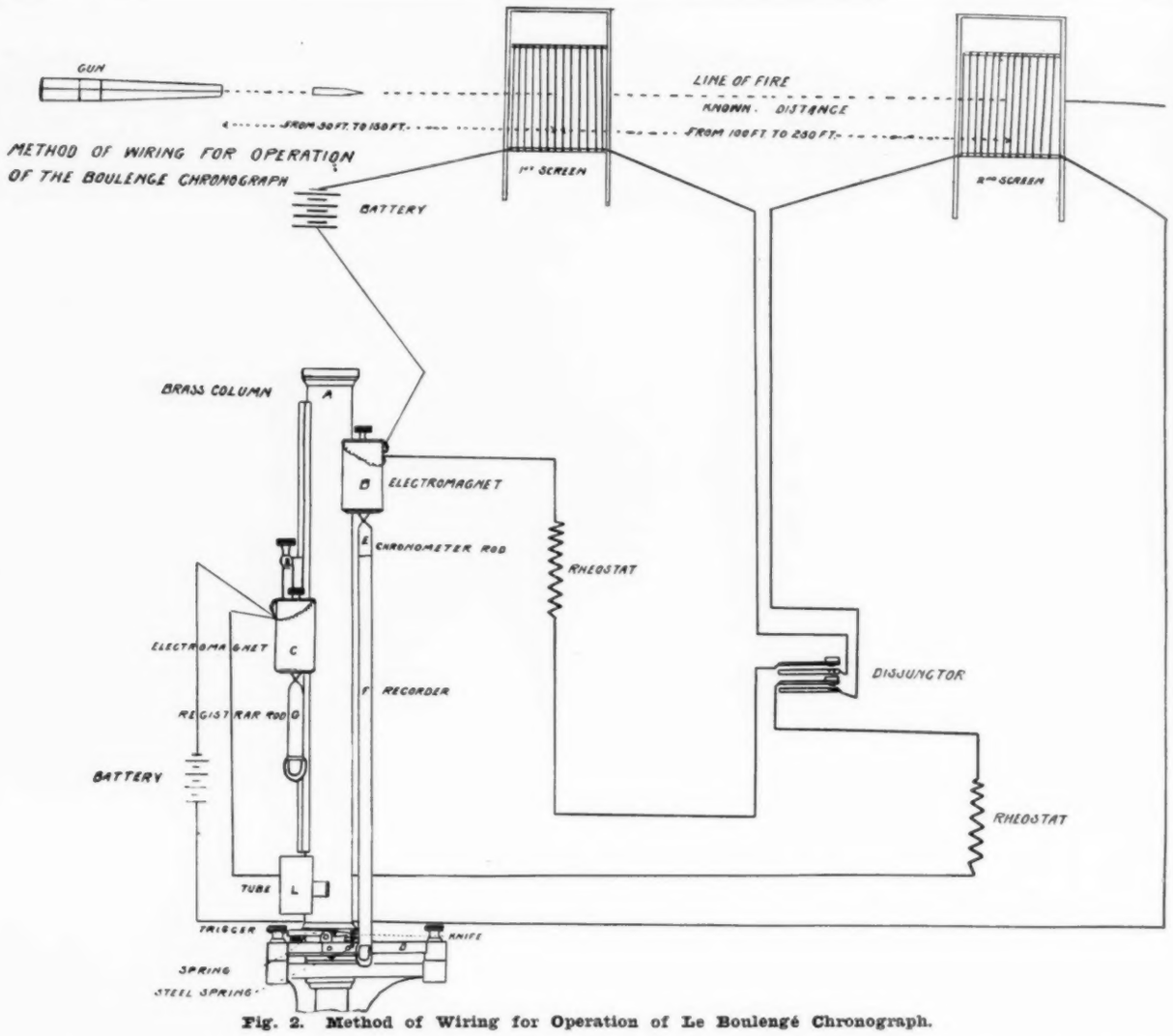


Fig. 2. Method of Wiring for Operation of Le Boulengé Chronograph.

When the registrar falls it encounters in its descent a horizontal plate or trigger by means of which a knife is actuated and makes an indenture on the recorder. If the two currents are broken simultaneously a dent will be found upon the recorder at the height, h, indicating that since the chronometer began to fall then has elapsed a time, t, such that

$$t = \sqrt{\frac{2h}{g}}$$

It is evident that t is no other than the time taken for the instrument to function.

A special instrument called the disjunctor permits the simultaneous breaking of the circuits so that the time, t, is always known. If the circuit of the registrar is not broken until after that of the chronometer and there has elapsed a time, T, between the two breaks, that interval during which the chronometer had fallen before receiving the imprint of the knife on the recorder, will simply be increased by T, and calling H, the height of the cut, we will have

$$t + T = \sqrt{\frac{2H}{g}}$$

Therefore, the determination of a time, T, always takes two operations, the determination of the time for the instrument to work, t, and the determination of the time, t + T, the difference between these two intervals giving the time sought. This indirect method of arriving at the result is characteristic of the instrument and explains its precision.

When the breaking of the circuit has been made by a projectile, we can consider the portion, D, of the trajectory a right line between the two wires cut and its velocity V at the middle point will be

$$V = \frac{D}{\sqrt{\frac{2H}{g}} - \sqrt{\frac{2h}{g}}}$$

If D, h, and H, have been measured exactly and the disjunctor has broken both circuits simultaneously, the error in velocity, V, will be quite small, provided the times of the functioning of the instrument at disjunction and on firing are the same.

The time of demagnetization of the electro-magnets must be considered and the instrument is so constructed as to reduce to a minimum errors arising from this cause.

In every day practice at Aberdeen Proving Ground three

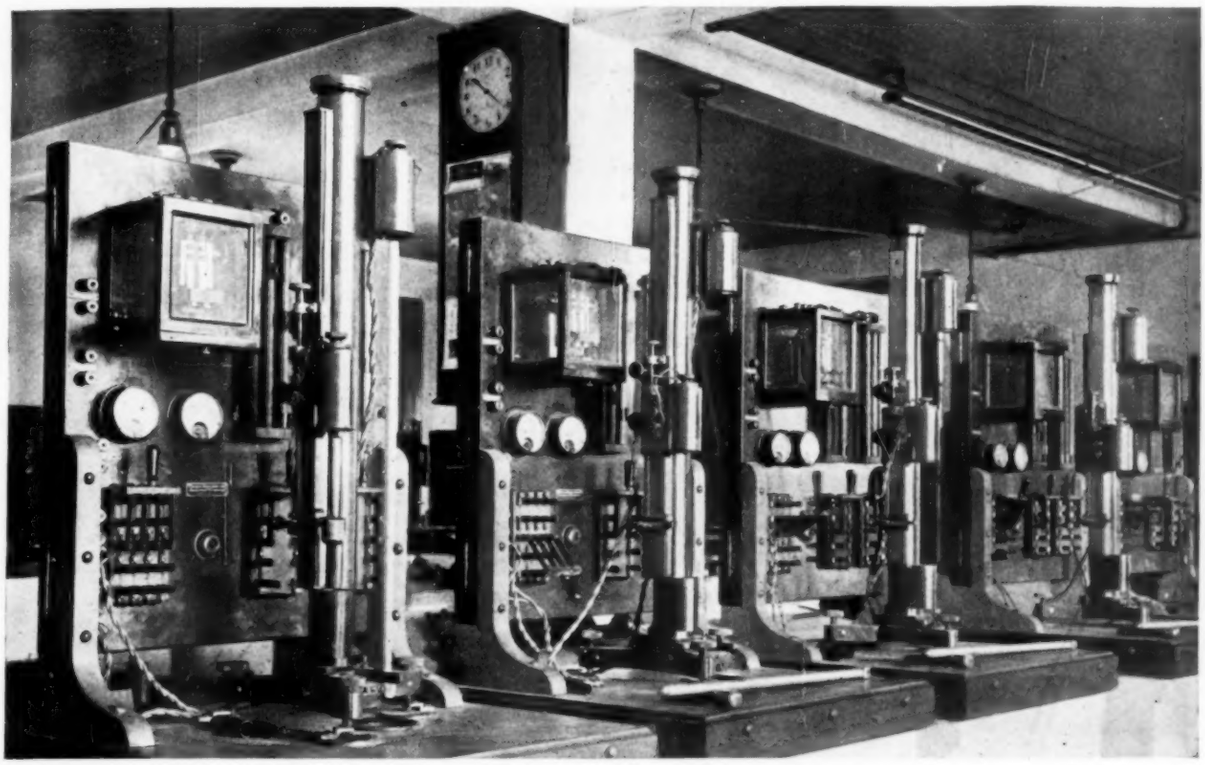


Fig. 3. Le Boulengé Chronographs on Permanent Pillars, Instrument Building, Aberdeen Proving Ground.

circuits are wound on each screen and three chronographs utilized, and more correct results obtained by taking the mean of the velocities obtained by the three instruments. The permanent installation at Aberdeen (Fig. 3) provides for eighteen instruments, by means of which velocities from six different guns may be obtained simultaneously. A well designed switchboard (Fig. 4) permits of quick connection of any set of three chronographs with any one of a great many firing points situated at widely separated positions about the Proving Ground. Velocities may be obtained as rapidly as forty (40) rounds per hour. Various tables and charts permit of simplifying the calculating and reducing the instrumental velocities to muzzle velocities.

From this description it is seen that the Boulengé Chron-

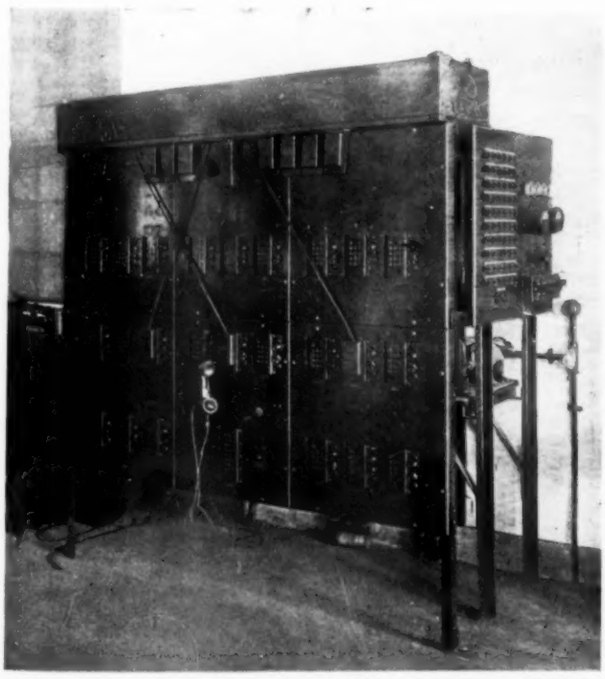


Fig. 4. Chronograph Switchboard, Aberdeen Proving Ground.

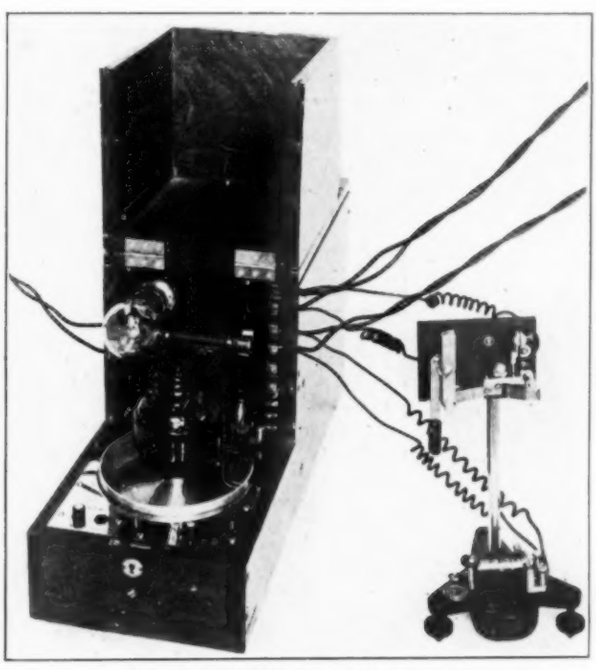


Fig. 5. The Aberdeen Chronograph.

ograph must be kept level and be so mounted as to eliminate extraneous jars and vibrations, that is, that it is purely a laboratory instrument requiring numerous electrical conductors for its operation. Its accuracy will be discussed later.

Fig. 6. Velocity Screens and Gun Ready for Use with the Aberdeen Chronograph.

The Aberdeen Chronograph

This instrument (Fig. 5) was developed at Aberdeen Proving Ground[2] during the years of 1918-1919 for the purpose of eliminating some of the errors attendant upon the firing of small-caliber guns for velocity and to provide for a portable or field type chronograph. The design and development of it were conducted by Maj. A. L. Loomis and Dr. Paul E. Klopsteg; Leeds and Northrup doing the excellent manufacturing portion of the work. Its construction, the method of installation (Fig. 6) and its capabilities are extensively discussed by Mr. D. A. Millar in an article entitled "The Aberdeen Chronograph," in Vol. IV, No. 22, of ARMY ORDNANCE.

Briefly, it is so constructed that when a projectile (Fig. 7) passes through a velocity screen, 20 and 21, consisting of two sheets of tin insulated from each other by a sheet of paraffin-coated paper an electric circuit is closed and a spark is caused to jump from a spark point, 11, to a drum, 1. This drum is revolved by a motor, 2, at a known constant speed and carries on its inner surface a strip of prepared paper which the spark pierces. Knowing the distance between the spark marks, the speed of rotation of the drum, and the screen distances, the instrumental velocity is readily obtained and the muzzle velocity determined. The inner circumference of the drum is 500 mm., the drum speed is 25 revolutions per second, so that

$$t \text{ (time in seconds)} = \frac{D \text{ (distance between sparks in milimeters)}}{25 \times 500}$$

and the instrumental velocity is

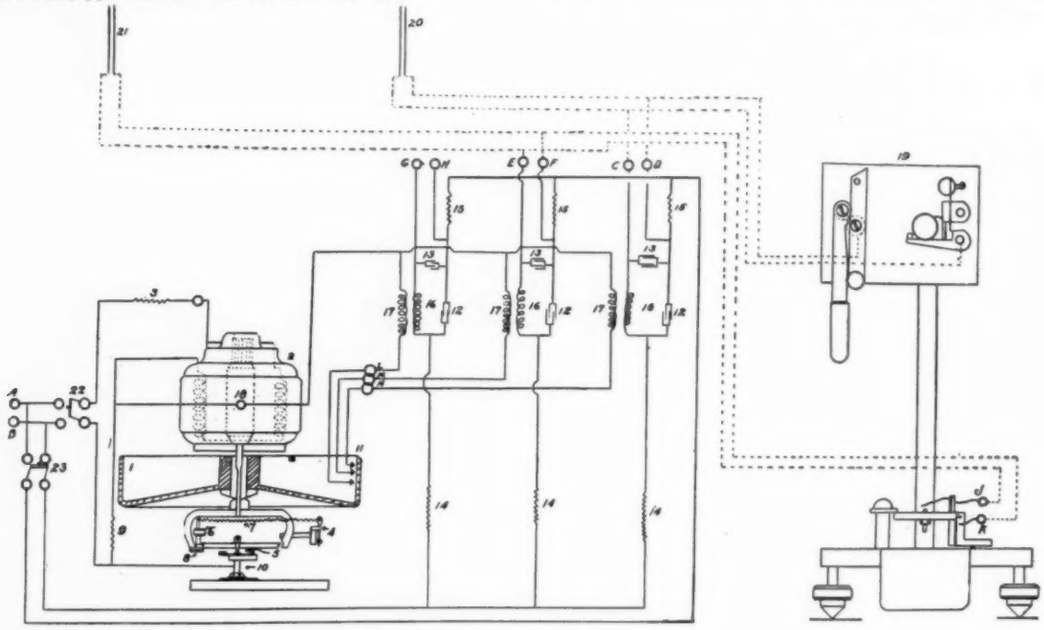
$$V = \frac{s \text{ (distance between screens in feet)}}{t}$$

or

$$V = \frac{12500\, s}{D}$$

Tables and charts facilitate the reduction of instrumental velocities to muzzle velocities. The governor which keeps the drum speed constant is quite accurate and dependable. The instruments are readily tested for speed of rotation by a device called a "fall instrument." This method is simple of operation, is portable, is rapid, and permits of a permanent record being obtained which may be measured at leisure. Three instruments connected in parallel to the

2. "Description and Instructions for the use of the Aberdeen Chronograph." Ordnance Pamphlet No. 2044.
"The Aberdeen Chronograph," by D. A. Millar, ARMY ORDNANCE, pp. 219-222, Vol. IV, No. 22, 1924.



Plan of Connections for Measuring Projectile Velocity with Two Screens; also Showing Fall Apparatus.

Fig. 7. Diagrammatic Sketch of Method of Operation of Aberdeen Chronograph.

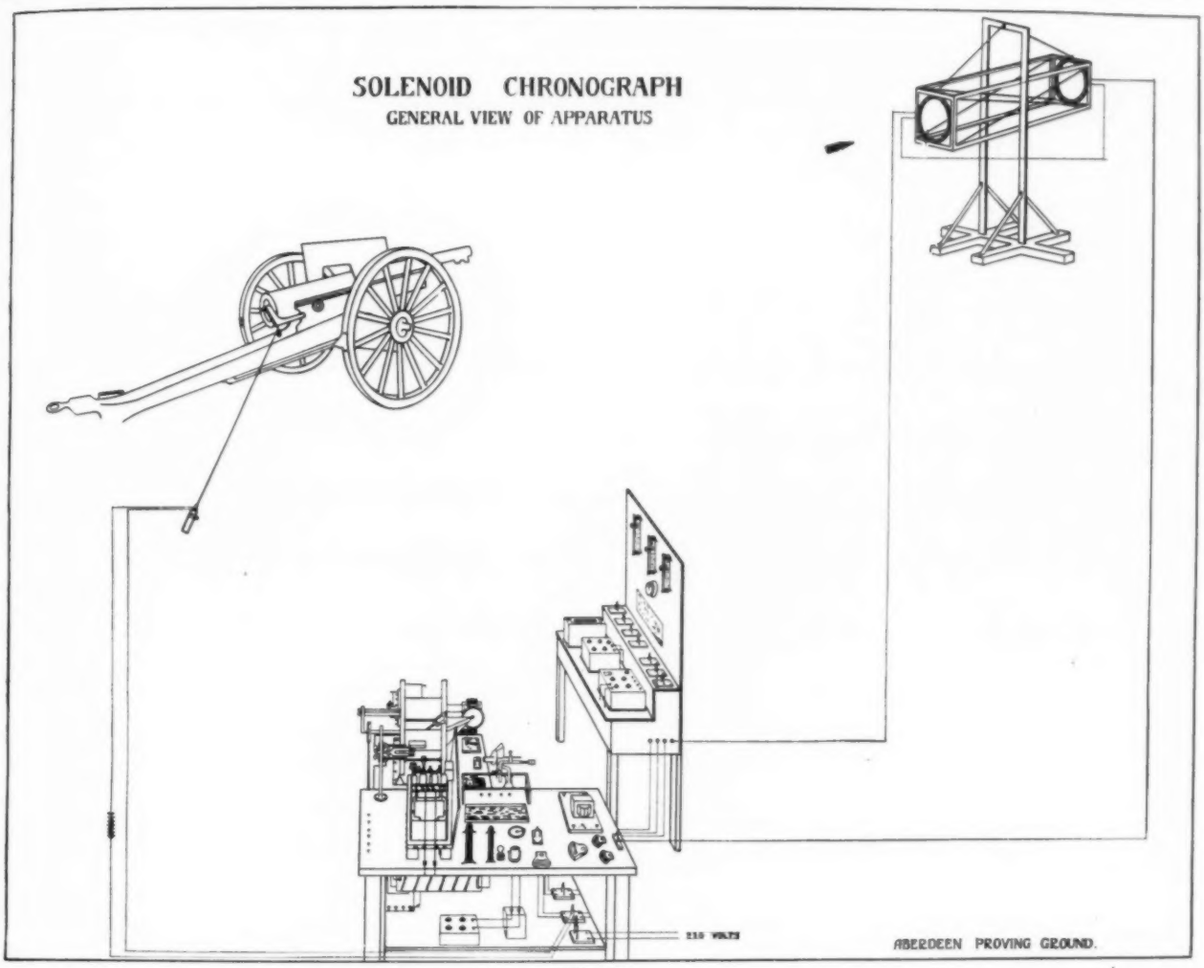

SOLENOID CHRONOGRAPH
GENERAL VIEW OF APPARATUS
ABERDEEN PROVING GROUND.

Fig. 8.

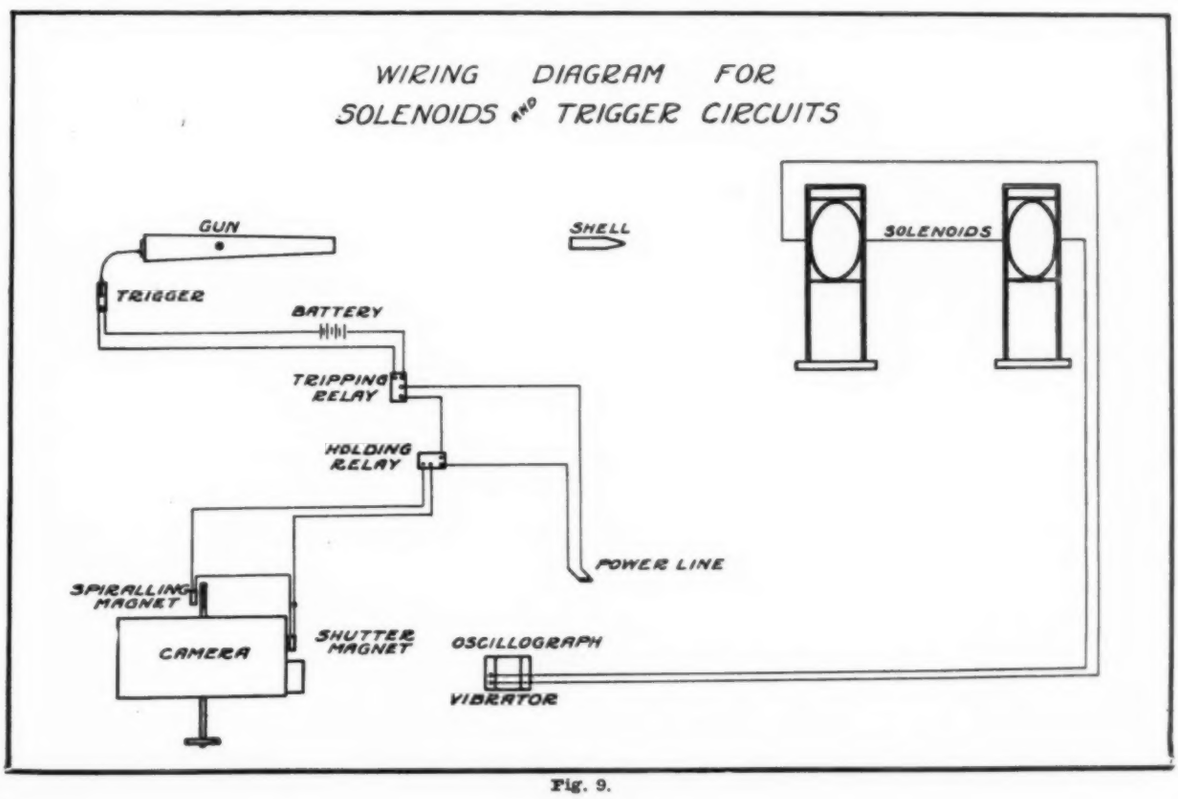

WIRING DIAGRAM FOR
SOLENOIDS AND TRIGGER CIRCUITS
GUN
SHELL
SOLENOIDS
TRIGGER
BATTERY
TRIPPING RELAY
HOLDING RELAY
POWER LINE
SPIRALLING MAGNET
CAMERA
SHUTTER MAGNET
OSCILLOGRAPH
VIBRATOR

Fig. 9.

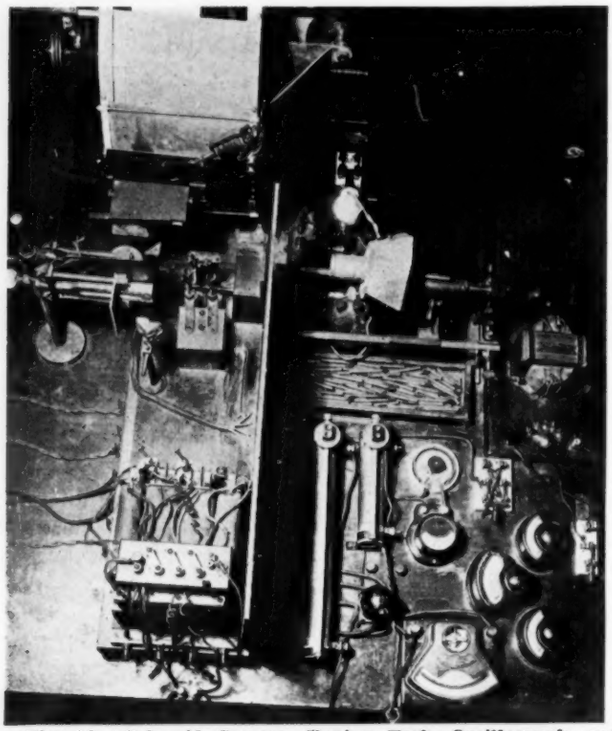


Fig. 10. Solenoid Camera, Tuning Fork, Oscillograph, and Arc Light of the Solenoid Chronograph.

screens are used at Aberdeen to permit of greater accuracy being obtained by taking the mean of the three instrumental velocities. The velocities of shell fragments are easily obtained with these instruments. The relative accuracy obtained will be discussed in connection with other instruments.

The Solenoid Chronograph

With the purpose in view of obtaining a chronograph of greater precision than then obtainable with existing instruments, the Ordnance Department conducted in 1918 at Sandy Hook experiments involving the use of solenoids and coils to record projectile velocities. Experiments of a similar nature were later conducted at Aberdeen Proving Ground. The British had developed an instrument of this type by the end of the World War. The Solenoid Chronograph,[3] in the form now used at Aberdeen, was developed at the Bureau of Standards and at Aberdeen Proving Ground during the years 1919-1922, those working on it at the Bureau of Standards being Dr. E. A. Eckhardt, Dr. J. C. Karcher, and Mr. M. Keiser; and those at Aber-

3. "Description and Instructions for the use of the Solenoid Chronograph." Technical Staff Reference Library, Office of the Chief of Ordnance.
"New Instruments for Physical Measurements." Col. W. H. Tschappat, Ord. Dept., U. S. A., Mechanical Engineering, pp. 673-8, Vol. 45, No. 12, 1923.
"A Precision High-Speed Oscillograph Camera." E. A. Eckhardt, Ph. D., Journal of the Franklin Institute, pp. 49-67, Vol. 194, No. 1, July, 1922.

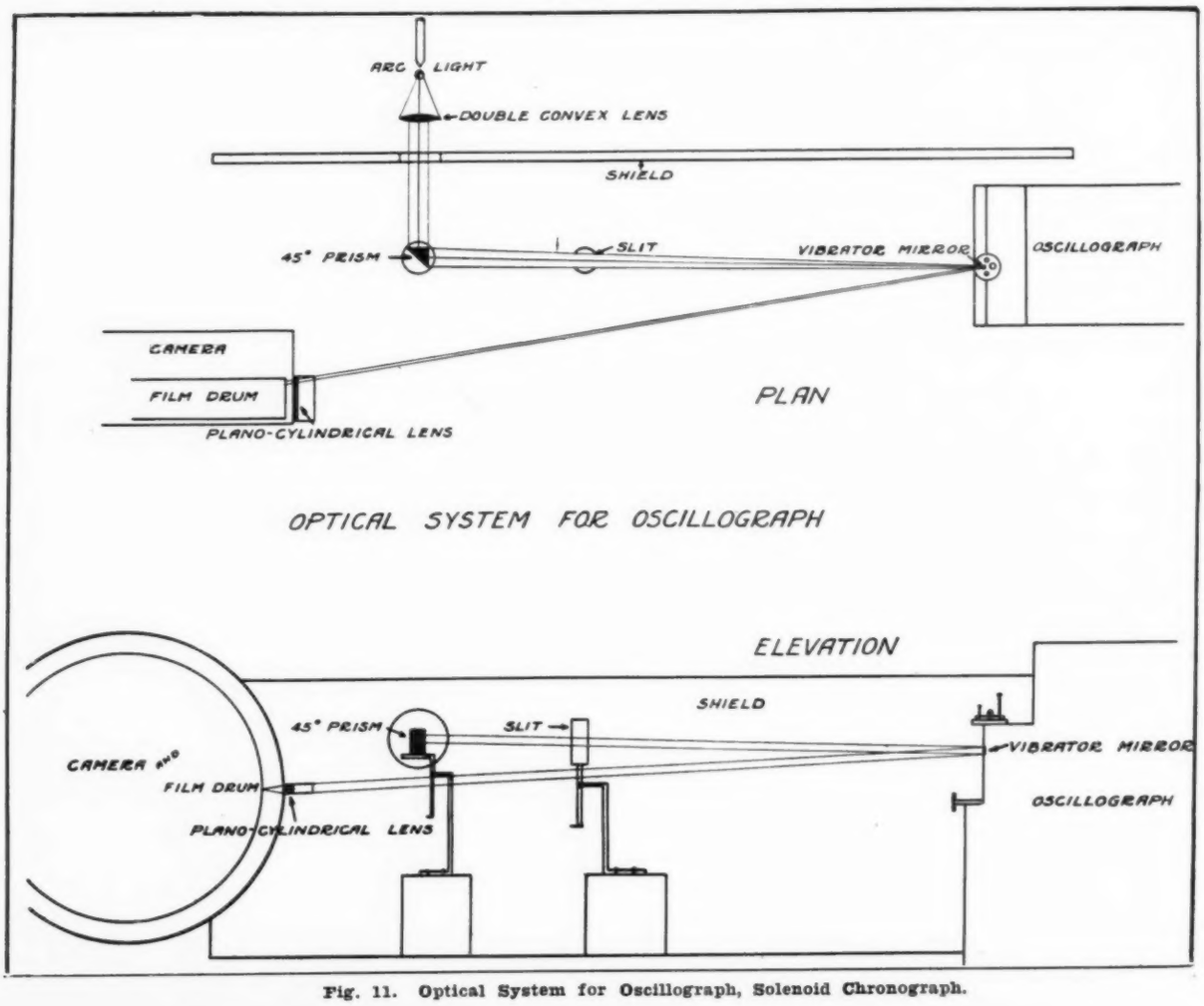


Fig. 11. Optical System for Oscillograph, Solenoid Chronograph.

deen Proving Ground being Dr. G. F. Hull, and Mr. R. H. Kent, and Mr. D. A. Millar. It consists (Fig. 8) of a set of coils or solenoids, connected, either directly or through the intermediary of a transformer, to an oscillograph vibrator of high frequency; a recording camera, a timing system, an arc light, and other appendages. When the gun is fired, a trigger device (Fig. 9) causes a relay to operate which opens the shutter of the camera (Fig. 10) and initiates the movement of the drum of the camera, carrying a sensitized paper or film, which rotates and at the same time moves in the direction of the axis of rotation. The projectile, previously magnetized, passes in flight through coils, producing in each, in turn, an e. m. f. This e. m. f. produced generates in the circuit, which includes the oscillograph element, a current which under certain conditions reproduces the shape of the e. m. f. curve. The current thus occasioned causes the oscillograph vibrator to be deflected and, under certain conditions, the deflection curve of the vibrator may be made to reproduce faithfully the current curve. This deflection curve of the vibrator is recorded on the moving film by the light from an arc light which is reflected from the vibrator mirror (Fig. 11). The curve obtained on the film is thus a more or less distorted reproduction of the e. m. f. curve generated by the projectile passing through the coils.

The timing marks are placed on the film by a beam of light which penetrates the slits in two metal plates attached to the prongs of a tuning fork which is driven by a vacuum

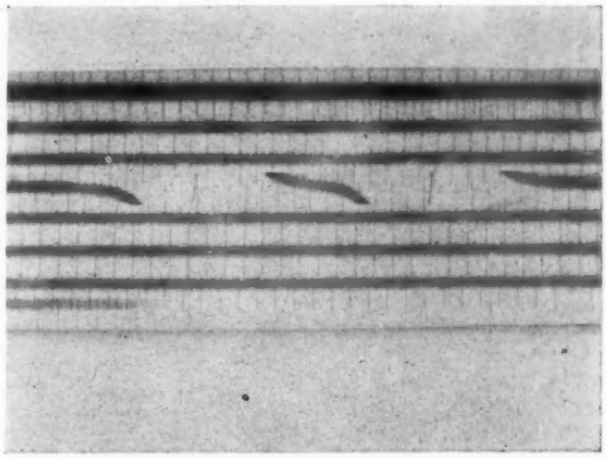


Fig. 13. Record made by Solenoid Chronograph Camera—Breaks in Lines indicate Passage of Projectile through Coils.

tube (Fig. 12). Twice in each complete cycle the slits come into opposition, allowing the light to pass and fall on the film (Fig. 13).

When the magnetic center of gravity of the shell is in the central plane of the coil, the flux through the coil is at its maximum and its rate of change is, therefore, zero. Thus the e. m. f. which is proportional to the rate of change of flux passes through zero at the moment when the magnetic center of gravity of the projectile passes through

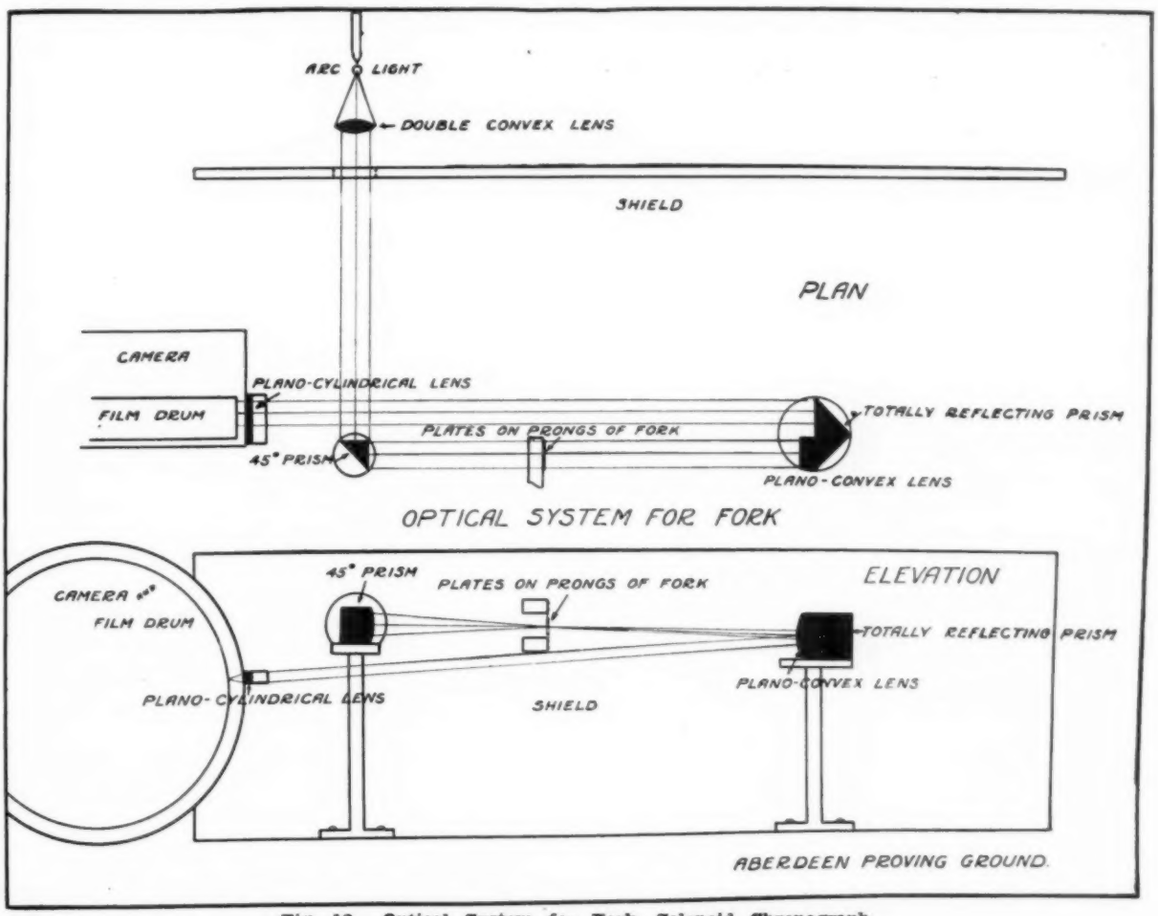


Fig. 12. Optical System for Fork, Solenoid Chronograph.

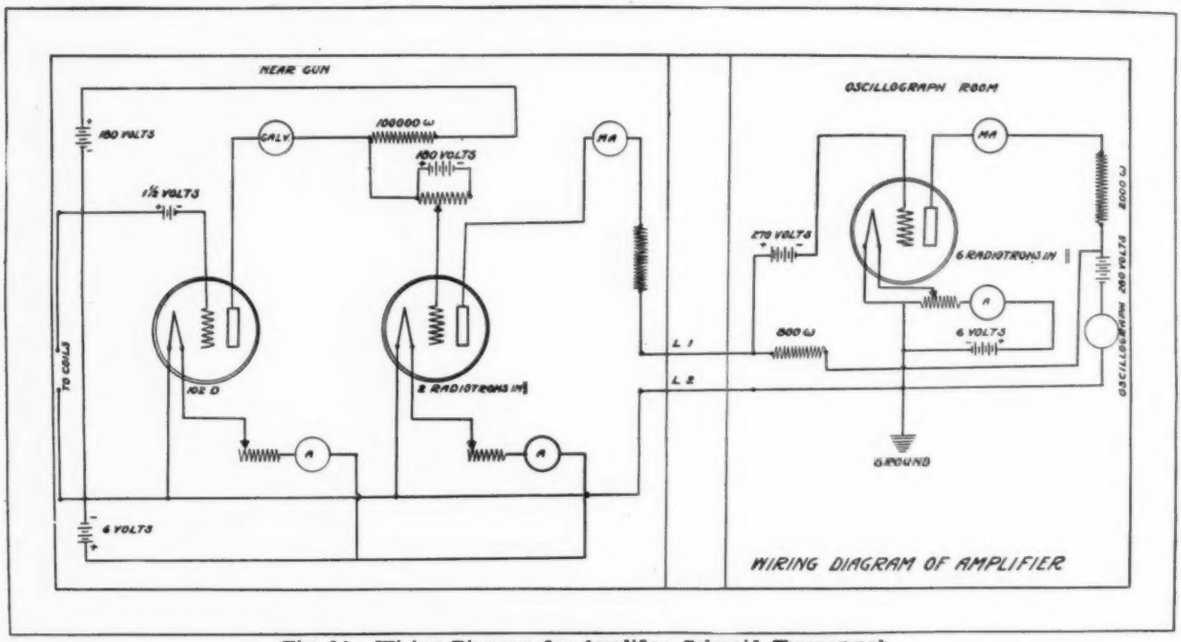


Fig. 14. Wiring Diagram for Amplifier, Solenoid Chronograph.

the central plane of the coil. Hence the time interval between two successive zero passages of the e. m. f. corresponds accurately to the time interval for the magnetic center of gravity of the projectile to pass from the central plane of one coil to that of the next, and, the coil distance being known, the average velocity of the projectile between the two coils may be obtained if the e. m. f. is accurately recorded.

By a proper selection of the electrical features of the circuits the relation between the e. m. f. curve and the current curve may be made such that reliable results are obtained.

The oscillograph element may, by a proper selection of characteristics, be made suitable to reproduce the current curve.

Two necessary characteristics of the oscillograph elements are: (1) sufficiently high frequency, (2) sufficiently small damping.

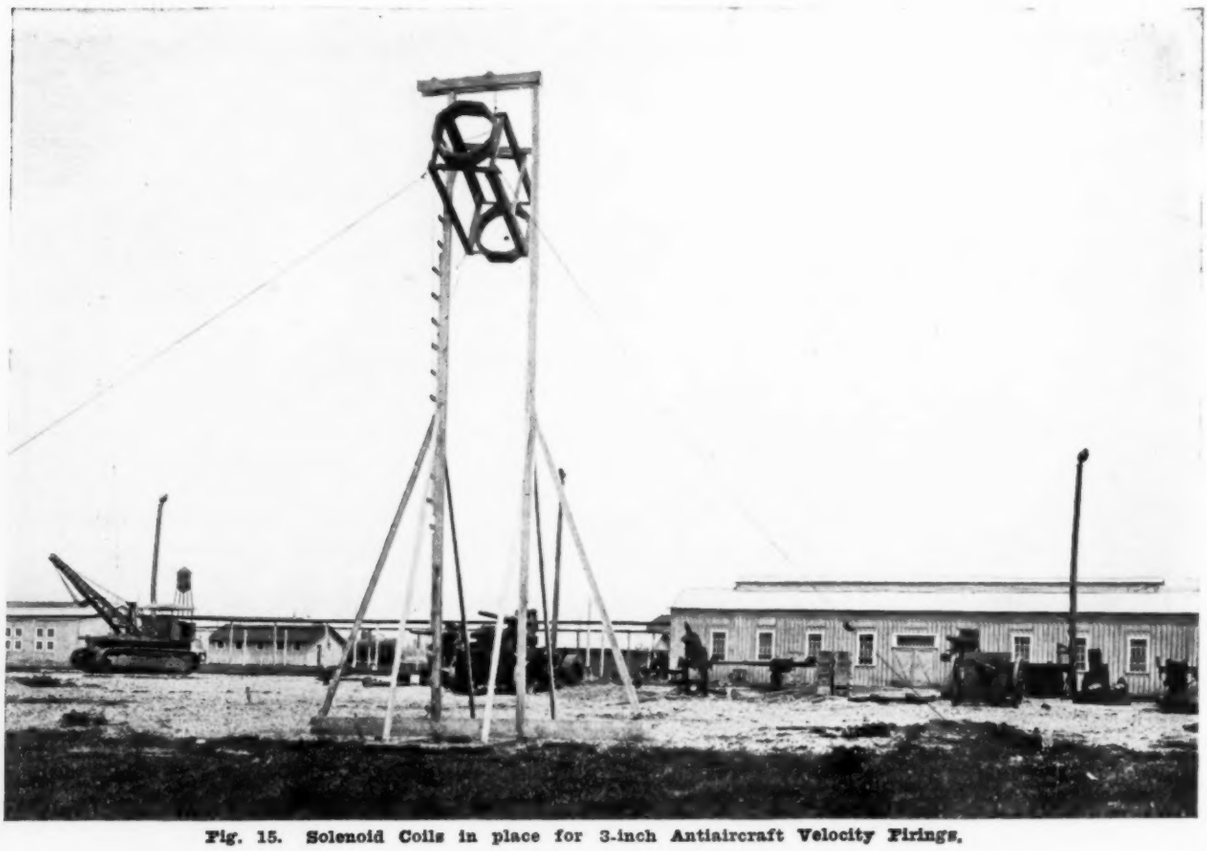


Fig. 15. Solenoid Coils in place for 3-inch Antiaircraft Velocity Firings.

A lower frequency may be used with large projectiles than with small ones. With electro-magnetic damping by means of aluminum strips it is difficult to make the damping much greater than 1/10 critical without greatly reducing the natural frequency of the vibrator.

With certain combinations of coils and projectiles, either because of weak magnetization or small size of the projectiles, it is impossible to obtain sufficiently great movement of the oscillograph vibrator with the installation as described. In such cases this difficulty is overcome by the introduction of amplification by thermionic vacuum tubes and greater precision is obtained than would otherwise occur. The amplifier (Fig. 14) is in two parts, the first tubes being placed in the immediate vicinity of the coils. The plate current from these tubes is sent to the oscillograph room where it is further amplified by means of the second set of tubes, before it is sent through the vibrator. This arrangement avoids the collecting of annoying extraneous radiation.

The Solenoid Chronograph has been extensively used at Aberdeen Proving Ground to obtain muzzle velocities and to obtain, by using several coils, the retardation of projectiles over a short portion of the trajectory near the gun. When but two coils are used they are normally mounted on either end of a framework which holds them rigidly a known distance apart (Fig. 15). This framework may be suspended in any convenient manner which will insure its position being maintained with reference to the muzzle and elevation of the gun. For antiaircraft work at high angles it has been found convenient to mount the framework on a boom which may be moved through vertical angles about a pivot located near the base of the mount (Fig. 16).

This method eliminates the need of replacing velocity screens for each round and avoids interference by such screens with the projectile in flight, allowing velocities to be taken of projectiles fitted with sensitive fuzes, so that in range firings the rounds observed for air burst or impact may also have their velocities determined and thus allow for proper comparison. Five velocities may be obtained on each film and the speed of conducting velocity determinations is quite rapid. The greater accuracy obtained warrants this more involved system being used in many cases. The relative accuracy will be discussed later.

Fig. 16. Solenoid Screen Boom for Antiaircraft Proof Firing Showing Mast and Winch for raising Boom.

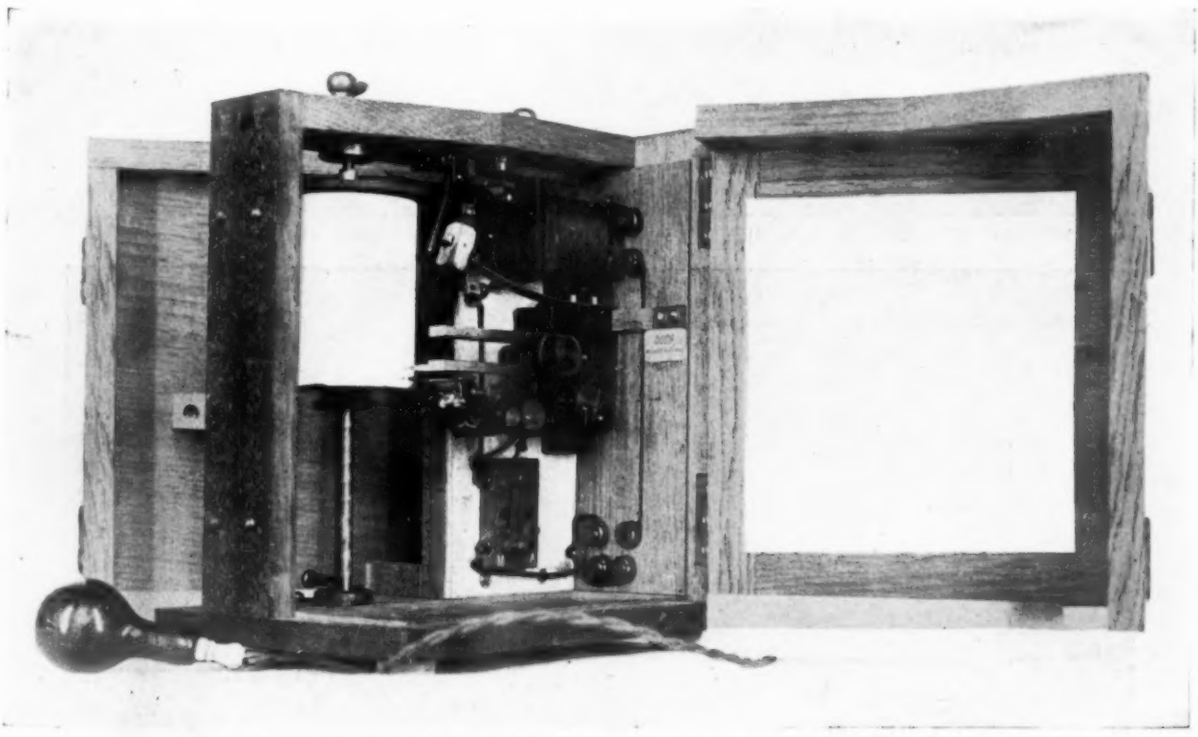


Fig. 17. Joly Chronograph with Hammer set preparatory to Firing the Gun.

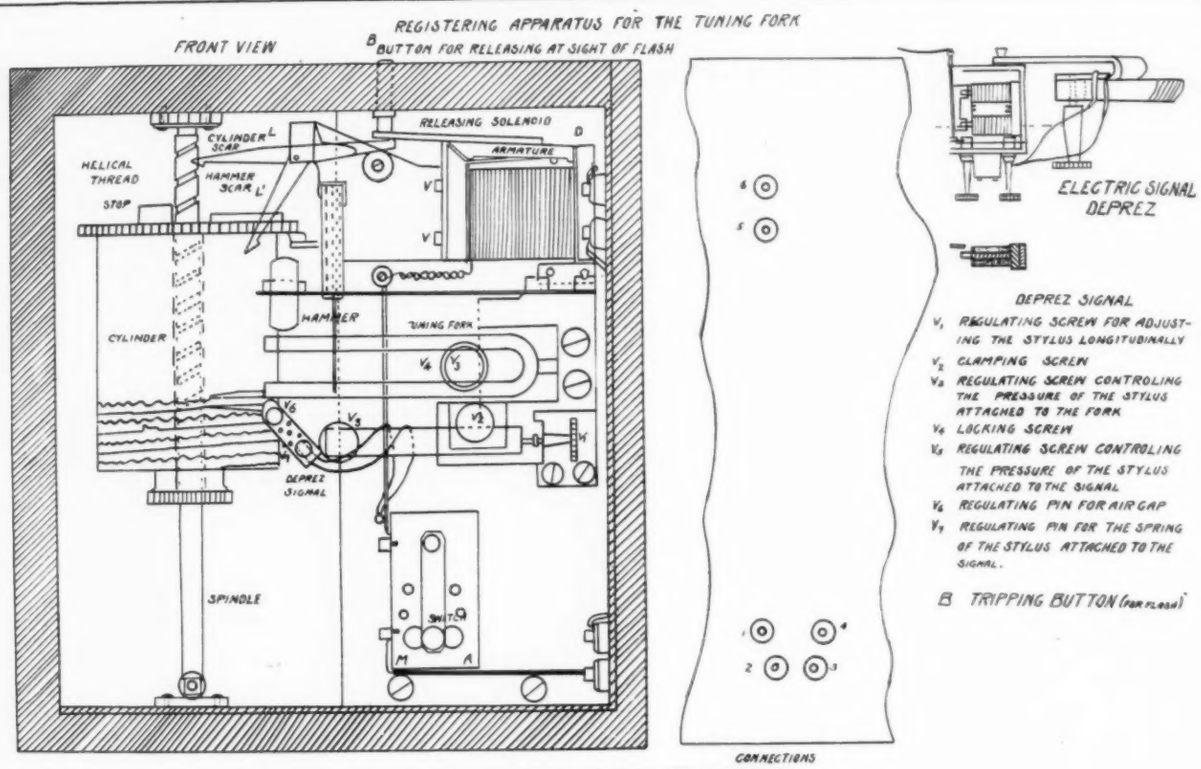


Fig. 18. Diagram of Joly Chronograph.

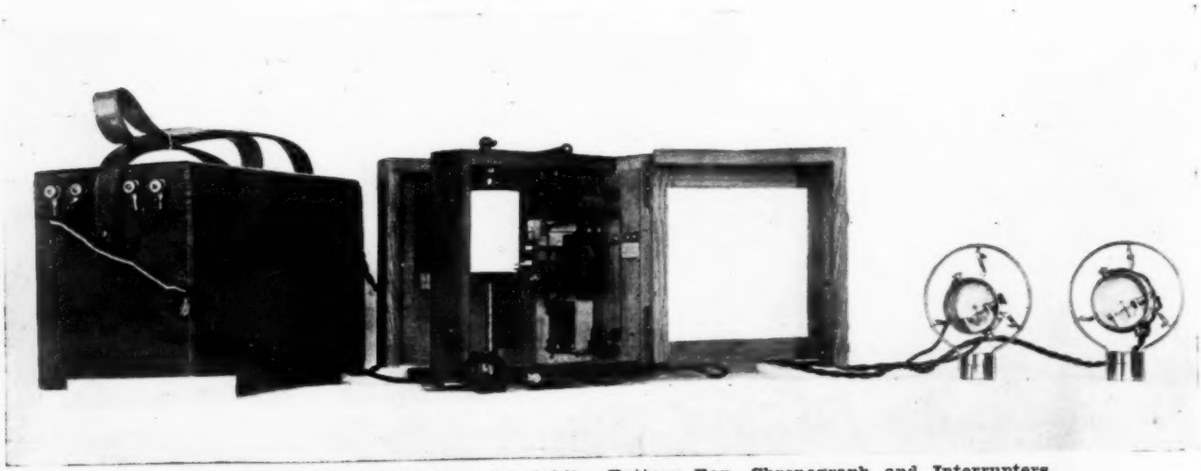


Fig. 19. Joly Chronograph (left to right): Battery Box, Chronograph and Interrupters.

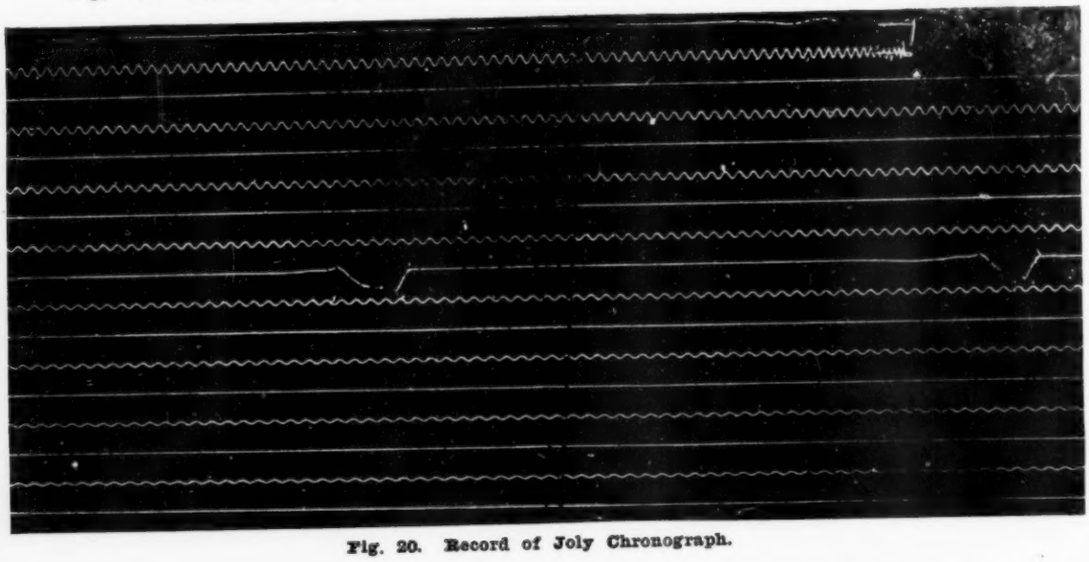


Fig. 20. Record of Joly Chronograph.

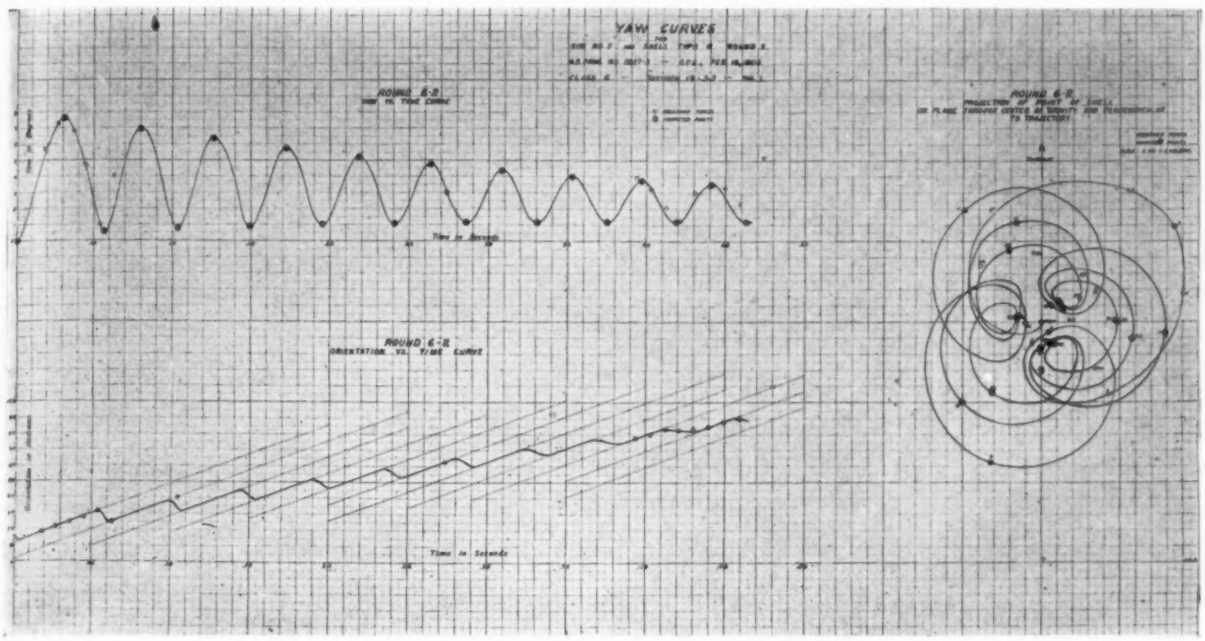


Fig. 21. Yaw Curve Determinations with Solenoid Chronograph.

The Joly Chronograph

The Joly Chronograph (Figs. 17 and 18), developed in France within recent years, has been tested and used to some extent at Aberdeen Proving Ground. For this method interrupters (Fig. 19), electrically connected to a recording device, are set up along a line parallel to the plane of fire. These interrupters are essentially a metallic membrane provided with a contact point of gold at its center against which is held by a spring a movable hammer or contact point of platinum. As the projectile moves through the air it generates a sound wave or ballistic wave, and when this wave vibrates the membrane, the hammer is moved, the circuit is opened, and this occurrence is recorded (Fig. 20) by means of a Deprez electro-signal on a rotating cylinder which moves in the direction of its axis of rotation. At the same time a tuning fork makes a time record on the cylinder. Knowing the distance apart of the interrupters and the distance from the trajectory the instrumental velocity of the projectile may be obtained.

Corrections must, of course, be applied for the height

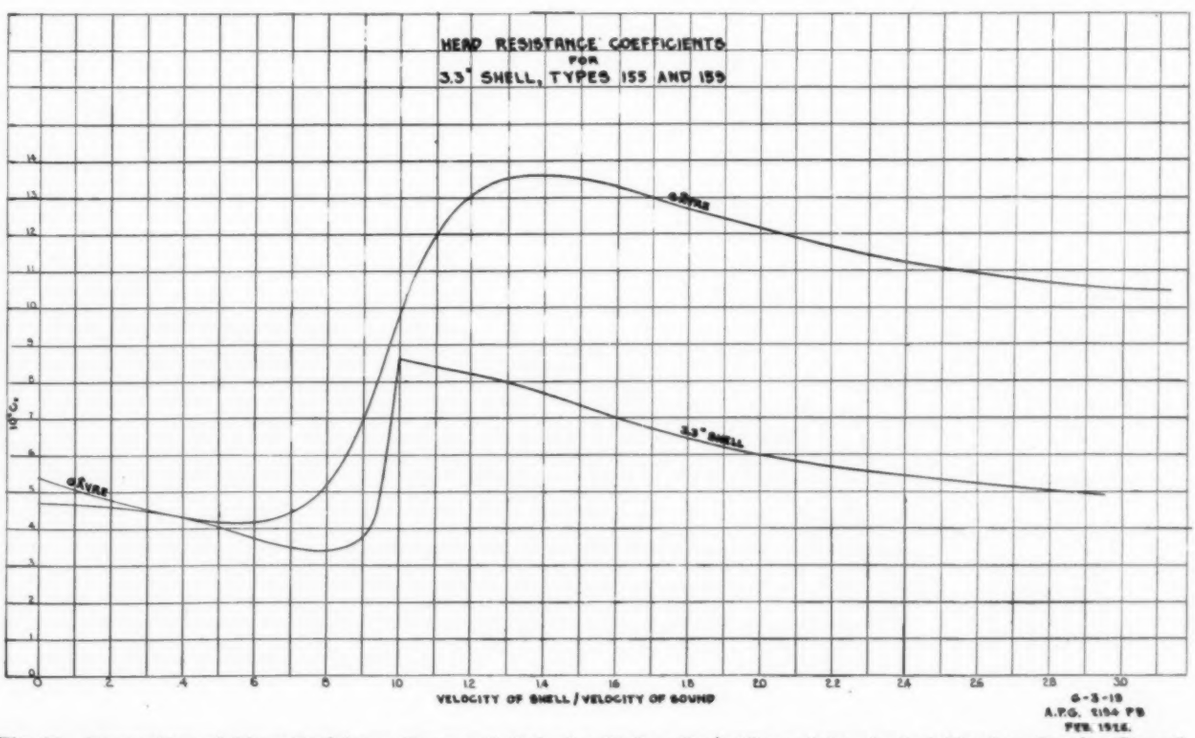


Fig. 22. Comparison of Gâvre Resistance Curve and that of a Modern Projectile as determined at Aberdeen Proving Ground.

of instruments and the velocity of sound, which is a function of the temperature, the wind, and of the vapor tension in the air.

The installation of the interrupters, the reading of the records, and the calculations of the instrumental velocities are quite laborious. At Aberdeen Proving Ground the best practice when using interrupters of this type is to use the camera and oscillograph of the Solenoid Chronograph as a recording device.

Comparative Accuracies

All of these four chronographs have desirable features and all of them have objectionable features. For example, the wires of the Boulengé Chronograph screens may stretch before breaking, thus introducing errors; the Aberdeen Chronograph screens may fail to close the circuit as the projectile passes through and no record be obtained; the Solenoid Chronograph record may take a long time to develop and dry so that it may be measured, which is objectionable; the reduction of the Joly Chronograph results are laborious and valuable time is consumed. Against such considerations we must weigh the accuracy to be expected in choosing a chronograph for a given purpose.

Comparative tests of these instruments made at Aberdeen Proving Ground have shown that the Solenoid gives the least mean deviation in velocities and that the Boulengé and Aberdeen deviations are larger and about equal. The Commission of Experiments at Calais in 1919 decided that "the precision of Le Boulengé-Breger and Joly Chronographs seem to be identical." The Joly is considered at Aberdeen Proving Ground to be a field type of instrument rather than a proving ground one.

The Solenoid has consistently shown a smaller dispersion in results than any other types. The deviations may vary with different types of projectiles, especially in the cases of the Boulengé and Aberdeen Chronographs. With the Aberdeen greater accuracy is to be expected with projectiles having more pointed heads, and small diameters; while with the Boulengé, blunt nose slugs will give the best results. The Commission of Experiments at Calais found that the Joly Chronograph functions normally whatever form of shell is used. Normally the Boulengé gives higher velocities than the Solenoid, due probably to its operation, because of practical consideration, in free air rather than a vacuum.

Tests have shown that under favorable conditions the Boulengé and Aberdeen instruments are capable of measuring short intervals of time with a mean error of 0.0001 sec., the error in the Boulengé being due mainly to variations in the time it takes the screen wires to break, and that this wave vibrates the membrane, the hammer is moved,

Results

By means of the Aberdeen Chronograph and various wooden panels the distribution and velocity of bomb and projectile fragments have been determined. With the Solenoid Chronograph and cardboard screens determinations of the yaw (Fig. 21) and air resistance of projectiles have been determined which have permitted better projectile design and have advanced our knowledge of the resistance of modern projectiles and the effects of various twists of rifling. A comparison of the Gâvre resistance curve and that of a modern projectile as determined at Aberdeen is shown in Fig. 22.

The Solenoid Camera and timing device is widely used for a variety of purposes which will be discussed at a later date.

Quite successful tests have been conducted with solenoid coils and amplifiers to actuate the Aberdeen Chronograph, thus combining the advantages of using both instruments. A comparison of the Boulengé and the Aberdeen-Solenoid gave a mean difference of 0.5 f/s, the Boulengé determinations being the larger.

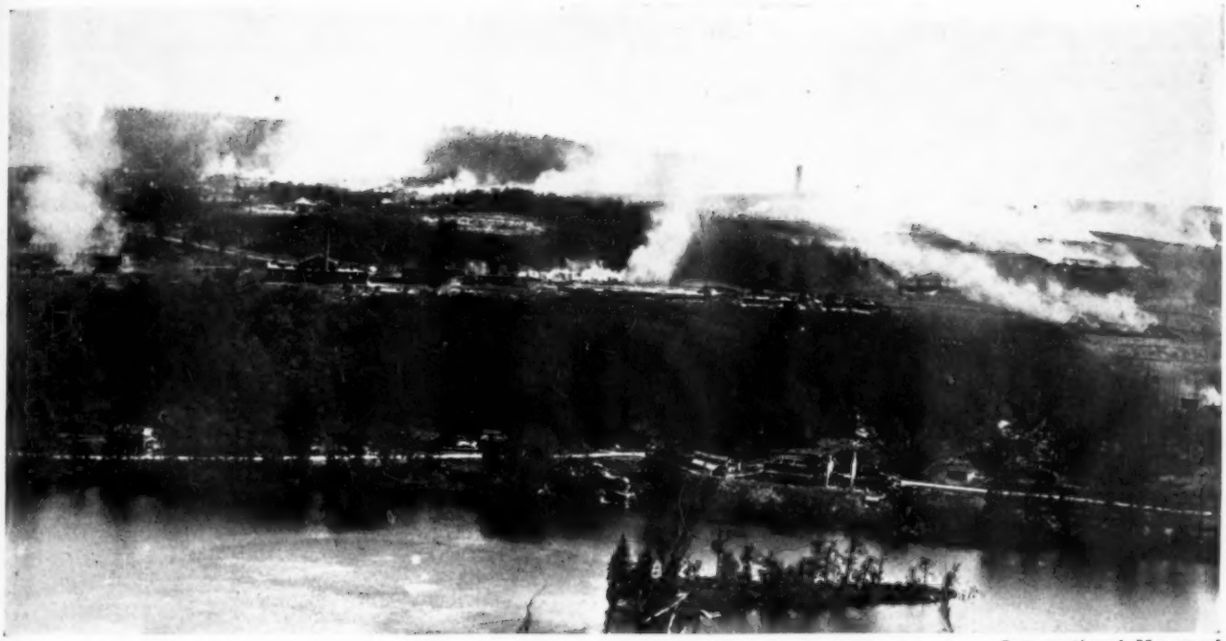
(Part II of this article will be published in an early issue of ARMY ORDNANCE*)*

Captured War Trophy Distribution Prescribed by Congress

THE Act of Congress approved May 22, 1926, providing for the equitable distribution of captured war devices and trophies to the states and territories of the United States has been published by the War Department "for the information and guidance of all concerned." The text of the act, in part, is as follows:

"Sec. 2. That for the purposes of this act the reports heretofore compiled under the direction of the Secretary of War showing the number of men in the armed forces of the United States accredited to each State, territory, and possession of the United States, and to the District of Columbia, either by enlistment or by the process of the Selective Service Act, or otherwise drawn into and becoming an integral part of the armed forces of the United States during the period April 7, 1917, to November 11, 1918, and the allotment of war trophies suitable for distribution among the several States, territories, and possessions, and the District of Columbia, shall serve as the basis of distribution.

"As soon as practicable after the date upon which this act shall become effective the Secretary of War shall cause the chief executive of each of the several States, Territories, and possessions, and the Commissioners of the District of Columbia to be informed of the character and quantity of war devices and trophies apportioned thereto, and shall invite each such chief executive and the Commissioners of the District of Columbia to designate such materials as will be accepted free on board common carrier at the point of storage and to designate the point or points to which the accepted material is to be shipped without expense to the United States other than that of packing and loading at the point of storage: Provided, That the Secretary of War is authorized to apportion and distribute such war devices and trophies, formerly contemplated by the said reports heretofore compiled as unsuitable for distribution as trophies, as he deems suitable for distribution, and to include the Canal Zone in such apportionment and distribution."



International Newsreel

A Seething Furnace—Lake Denmark Depot Viewed From Picatinny Peak, Picatinny Arsenal.

The Naval Ammunition Depot at Lake Denmark, N. J., and Picatinny Arsenal, the Army Powder Factory and Experimental Explosive Plant, adjoin. The photo shows Picatinny Lake and a portion of the demolished Army Powder Factory and Power Plant buildings in the foreground. In the rear, surmounting a high hill, some of the burning magazines and wrecked buildings on the Naval Reservation are shown. The picture was taken during the second day of the conflagration.

The Lake Denmark Naval Ammunition Depot Disaster

Report of Naval Court of Inquiry

THE report of the Court of Inquiry which investigated the explosions at the Naval Ammunition Depot at Lake Denmark, N. J., on July 10, 1926, as a result of which Picatinny Arsenal, the huge Ordnance establishment close by was partly demolished, was approved by the Acting Secretary of the Navy, T. Douglass Robinson, August 3, 1926. The finding of facts, opinions and recommendations of the Court of Inquiry are published below in full.

Secretary Robinson stated that the necessary steps would be taken immediately to carry out the recommendations of the Court. The recommendations, as far as they deal with the storage or handling of explosives, will be studied by the Bureau of Ordnance, U. S. Navy, and other bureaus affected in conjunction with the Secretary and will be put into effect as soon as the problems presented have been solved.

The Court of Inquiry was headed by Rear Adm. Robert E. Coontz, U. S. N. It covered the investigation into the damages to the Naval Ammunition Depot, into the loss of life on the Naval Depot, and into the cause of the explosions. It was charged with rendering its opinion of the cause of the disaster, and was ordered to make any recommendations which it "might deem pertinent in the light of this inquiry whereby future disasters of this nature might be averted."

The full text of finding of facts, opinions and recommendations follows:

Finding of Facts

1. That the Naval Ammunition Depot, Lake Denmark, N. J., comprises an area of 456 acres of hilly land of which 317 acres were originally transferred from the War Department to the Navy Department, 9 June, 1891. The original area was added to by purchase of 75 acres by authority of Congress in 1902; and again by 64 acres by Executive Proclamation in 1918. This land is partly overgrown by trees and brush and is served by railroad tracks giving access to the buildings and by a macadam highway transversing it irregularly throughout. It includes approximately 200 buildings, used for storage 10 July, 1926, as follows: 10 for High Explosives, 19 for Smokeless Powder, 13 for Projectiles, 11 for Black Powder, the remainder being storehouses, dwellings, and industrial buildings not containing explosives.

2. That the condition of the plant and its contents on

July 10, 1926, was very good. The buildings, including temporary buildings, were of approved type and in good repair and the explosives and smokeless powder were of standard grade and in good condition. The buildings were constructed at different periods, in each case to meet the storage necessities of the time. The number of buildings was largely augmented at the period of the World War.

The ammunition was segregated in various magazines, by classes, high explosives, smokeless powder, projectiles, black powder and inert materials, in accordance with Bureau of Ordnance instructions. The required inspections had been made.

The buildings in which explosives were stored were of approved fireproof construction, all equipped with lightning protection which was in good condition, and the explosives were stored in approved containers.

3. That the storage of explosives at Lake Denmark was believed by all responsible officers to present no danger other than the danger inherent and unavoidable in the storage of large quantities thereof.

4. That temporary magazines 8 and 9, and shell house 22 contained large quantities of cast TNT in depth charges or aerial bombs.

5. That TNT was stored in bulk in large quantities in other magazines, and in the south end of temporary magazine No. 9.

6. That the value of the real property and plant was $3,460,747.06 as of 1 July, 1925, and was substantially the same on 10 July, 1926.

The value of all stores and materials on 10 July, 1926, was $84,399,506.29.

7. That on the afternoon of 10 July, 1926, there was a severe electrical storm at Lake Denmark.

8. That lightning crashed within the Ammunition Depot or near the southwest end thereof at about 5:15 P. M.

9. That almost immediately thereafter black smoke was seen issuing from the northeast side of Temporary Magazine No. 8.

10. That shortly thereafter an alarm of fire was sounded for the 4th district of the Ammunition Depot, which comprised the southern end of the Depot.

11. That personnel on the station responded immediately to the fire call.

12. That at least one stream of water was played on the fire.

13. That about 5:20 P. M. a tremendous detonation occurred at the scene of the fire.

14. That a second tremendous detonation occurred at about 5:25 P. M.

15. That the first detonation did great damage by collapsing roofs, blowing down walls, opening doors, or otherwise damaging many of the other magazines and buildings at the Depot, thus exposing their contents to the spread of fire.

16. That this condition was aggravated by the second detonation.

17. That the contents of other buildings in the immediate vicinity were quickly ignited by embers, missiles, or by the direct heat effects of the blast.

18. That the fire spread quickly, igniting other magazines and shell houses.

19. That a number of minor explosions ensued, including another tremendous detonation at about 5:45 P. M.

20. That two large craters were formed on the site of Temporary Magazine No. 8, which building, together with its foundations, has entirely disappeared.

21. That a large crater of later origin was formed on the site of Temporary Magazine No. 9 and that this building also, together with its foundations has entirely disappeared.

22. That a large triple crater was formed on the site of shell house No. 22, and this building, together with its foundations, has entirely disappeared. The vicinage of this building is covered by scattered projectiles, and other missiles from this shell house are found scattered about the ground within a radius of about half a mile.

23. That TNT stored in large quantities in other magazines, in bulk, in standard packages, burned freely without detonation.

24. That Explosive D stored in Temporary Magazine No. 11 in standard barrels and boxes to the amount of about 2,500,000 pounds, as well as smaller quantities stored in other magazines, burned freely without detonation.

25. That smaller quantities of picric acid in standard packages burned freely without detonation.

26. That in all cases smokeless powder burned without detonation.

27. That there is no evidence of loaded and fuzed projectiles exploding with high order detonation.

28. That fragments of steel beams and trusses were found at distances approximating 5,000 feet from the site of detonations.

29. That the detonation of Temporary Magazines 8 and 9 caused complete destruction of all surface buildings within a radius of 2,700 feet, and that structural damage was done to a magazine-building of modern construction belonging to the Picatinny Arsenal at a distance of 8,700 feet, in an unbarricaded direction.

30. That the eighteen small sub-surface magazines were virtually undamaged and their contents are intact.

31. That the salvage value of the munitions and other stores is over $40,000,000.

32. That the following U. S. Navy and Marine Corps personnel were killed by the explosion and their bodies have been recovered and identified.

Navy: Lieut. Com. (MC) Edward Allan Brown, Signal No. 5754; Lieutenant Herman Conrad Schrader, Signal No. 2029; Harry Christian Brown, Pharmacist's Mate, First Class, Serial No. 213-65-54.

Marine Corps: Capt. Burwell Haydn Clarke, Signal No. 9787; Trumpeter Mason D. Eidson; Privates Ralph V. P. Graham, Jr.; John W. Monroe; Maurice R. Hardaker; Frank C. Weber; Orlando M. Alfson; Virgel C. Baker; Ernest Powell; Henry D. Mackert, Jr.

33. That is it proved beyond any doubt that the following Navy and Marine Corps personnel were killed in the disaster, but their bodies are not yet identified:

Chief Gunner Joseph Matthias Gately, U. S. Navy, Signal No. 8005; Corporal Frederick J. Rachford, U. S. Marine Corps; Private John H. Little, U. S. Marine Corps.

34. That all of the before-mentioned officers and men were killed as a direct result of their fearless performance of duty.

35. That the following are still unaccounted for:

Private Oliver C. Bliss, U. S. Marine Corps; Private Paul W. Moreau, U. S. Marine Corps.

These men went on authorized liberty which expired July 11, 1926, and were last seen near the railroad station in Dover, N. J., at about 1:30 P. M. 10 July, 1926, having stated their intention of going to New York. The Court is unable to establish whether or not they were killed in the disaster.

36. That four bodies were recovered, believed to be those of Navy or Marine Corps personnel, and have not been identified.

International Newsreel

Aerial View of the Lake Denmark Naval Ammunition Depot during the fire and explosions. Burning magazines and craters where magazines once stood are shown.

37. That the following civilian personnel were killed in the disaster:

Mrs. H. D. Wadhams, wife of the Chief Clerk of the Ammunition Depot (body recovered); Mrs. Frances Feeney, a visitor at the house of Chief Gunner Gately, fatally injured, died in hospital.

NOTE.—The above enumeration of killed does not include 1st Lieut. George W. Bott, Jr., U. S. A., who was killed off the Naval Reservation, and is therefore not included in this enumeration.

38. That the following Navy and Marine Corps personnel were injured in the disaster:

Capt. Otto C. Dowling, U. S. N.; Chief Gunner William A. Gerdts, U. S. N.; Bernard J. Shackman, Pharmacist's Mate, First Class, U. S. N.; Sergeants P. Donaldson, U. S. M. C.; J. C. Parker, U. S. M. C.; Corporals J. H. Nelle, U. S. M. C.; L. C. E. Pelletier, U. S. M. C.; E. A. Schry, U. S. M. C.; C. A. Dettenbach, U. S. M. C.; Axel Frederickson, U. S. M. C.; Marvin Lewis, U. S. M. C.; M. E. Prather, U. S. M. C.; Privates C. M. Hedrick, U. S. M. C.; Charles Hungler, U. S. M. C.; C. L. Lindsey, U. S. M. C.; John Pratt, U. S. M. C.; S. L. Boggs, U. S. M. C.; Albert Burg, U. S. M. C.; G. J. Bush, U. S. M. C.; D. L. Brundidge, U. S. M. C.; G. V. Hertig, U. S. M. C.; Z. V. Kirks, Jr., U. S. M. C.; Thomas Johnston, U. S. M. C.; J. R. Sullivan, U. S. M. C.; J. M. Weaver, U. S. M. C.; E. A. Webb, U. S. M. C.; H. L. Hyde, U. S. M. C.; L. C. Jones, U. S. M. C.; C. L. Roy, U. S. M. C.; H. R. Engel, U. S. M. C.; E. F. Ervin, U. S. M. C.; L. J. Klauzenberg, U. S. M. C.; G. J. Mathis, U. S. M. C.; C. A. Nutt, U. S. M. C.; O. D. White, U. S. M. C.; W. A. Taylor, U. S. M. C.; C. M. Kensick, U. S. M. C.; E. S. Roberts, U. S. M. C.; John Singleton, U. S. M. C.

39. That the following civilian personnel present on the Naval Reservation was injured by the disaster:

Mr. H. D. Wadhams, Chief Clerk; Mr. William Skews, employee (engineman on watch); Mr. William Barrass, employee (fireman on watch); Mrs. O. C. Dowling, wife of Captain Dowling, U. S. N.; Mrs. H. C. Schrader, wife of Lieutenant Schrader, U. S. N.; Miss Frances Schrader, daughter of Lieutenant Schrader, U. S. N.; Mrs. J. M. Gately, wife of Chief Gunner Gately, U. S. N.; Mrs. B. Burdick, wife of First Sergeant Burdick, U. S. M. C.; Dorrence Burdick, son of First Sergeant Burdick, U. S. M. C.; Mrs. Matilda Koch, wife of civilian employee; Mr. Amatus Feeney, visitor of Chief Gunner

Gately; Miss Jane Feeney, visitor of Chief Gunner Gately; Mr. Marion Schoenholz, visitor of Lieutenant Schrader, U. S. N.

Opinions

The court is of the opinion:

1. That electric storms occur with more than average severity in the Lake Denmark area.

2. That there is at present no well tried out generally approved system which can absolutely guarantee the protection of a surface building against lightning, and that lightning therefore remains a serious menace to surface buildings containing explosives.

3. That the fire in Temporary Magazine No. 8 was caused by lightning, either from a heavy direct stroke or by induced currents, despite the fact that the building was equipped with lightning protection in accordance with the best practice of the day.

4. That Temporary Magazine No. 8 was the first magazine to detonate, followed shortly by Temporary Magazine No. 9, and some twenty minutes later by Shell House No. 22.

5. That the spread of fire was materially assisted by the wood used both in parts of the magazines and in some of the containers.

6. That in the light of present knowledge the area of the Lake Denmark depot is too small and its situation too near inhabited land for the safe storage of more than small amounts of high explosives.

7. That as a result of the sudden close of the war greater stocks of munitions than anticipated were left on hand thus making necessary certain congested conditions of storage. These conditions were being remedied by restorage, expenditures, and actual dumping at sea of material which it was hazardous to keep; and at the time of the disaster, such progress had been made that the Depot was considered by all responsible officers to be safe, having due regard to the inherent and unavoidable danger which always attends storage of large quantities of explosives. Thirty-five years' experience at this Depot without explosion attests the accuracy of this statement.

8. That as different explosives act differently, and even the same explosive, in different containers, may act in different ways, the segregation of explosives by types of containers as well as by kinds, is very necessary.

9. That the damage to plant, property, and stores will approximate $47,000,000, exclusive of a relatively small amount of Army ammunition stores in the Naval Reservation.

10. That the loss of life would have been greater but for the fact that the accident occurred late on a Saturday afternoon, when only a small maintenance force was on duty or at work. It is to be noted that every officer attached to the station was on the reservation at the time of the disaster.

11. That the evidence shows beyond all doubt that the Navy and Marine Corps personnel who were killed met their death while heroically carrying out their duty in the face of imminent peril of which they were thoroughly cognizant and that therefore their deaths were directly in the line of duty and in no degree due to their own misconduct.

12. That the evidence clearly shows that each officer and man on the station, both of the Naval Service and the civilian employees, promptly, fearlessly and devotedly, responded to the call of duty, well knowing the danger involved, thus showing a high state of morale reflecting great credit on Capt. Otto C. Dowling, U. S. N., the Inspector of Ordnance in Charge, and upon every officer and man attached to the station.

13. That the conduct of Capt. Otto C. Dowling, U. S. N., in fearlessly exposing himself to danger at the time of the first explosion, and although injured, in devotedly remaining for ten hours at his post of duty in the hope of checking the spread of the disaster, until he became temporarily totally blinded from injuries, is deserving of the highest commendation.

14. That the conduct of Lieut. Herman Conrad Schrader, Chief Gunner Joseph Matthias Gately, Lieut. Com. Edward Allan Brown (M. C.), and Capt. Burwell Haydn Clarke, U. S. M. C., who best realized the imminence of the great peril, yet faced death grandly, was well worthy of the highest traditions of the service.

15. That the conduct of the following named enlisted men of the Navy and Marine Corps who were killed while fearlessly carrying out their duties at a time of great peril, again exemplifies the manner in which our enlisted men can be counted on in a time of dangerous emergency:

Harry Christian Brown, Ph. M. 1c., U. S. N.; Corporal Frederick J. Rachford, U. S. M. C.; Trumpeter Mason D. Eidson, U. S. M. C.; and Privates Ralph V. P. Graham, Jr., U. S. M. C.; John W. Monroe, U. S. M. C.; Frank G. Weber, U. S. M. C.; Henry D. Mackert, Jr., U. S. M. C.; Maurice R. Hardaker, U. S. M. C.; Orlando M. Alfson, U. S. M. C.; Ernest Powell, U. S. M. C.; John H. Little, U. S. M. C.

16. That the conduct of Private Casmer M. Kensick, U. S. M. C., in remaining with and aiding his Commanding Officer, Capt. Otto C. Dowling, is worthy of highest praise.

17. That the conduct of Mr. Henry D. Wadhams, Chief Clerk of the Ammunition Depot, in doing his utmost to carry out the orders of Capt. Otto C. Dowling during and after the disaster, regardless of his personal safety, while suffering from a severe injury, was nothing short of heroic.

18. That the location of the Depot, the type, number, location and protection of magazines, and the manner of storage of explosives therein, were all in accordance with approved practice for governmental depots.

Furthermore there is no instance shown of any fault, negligence or inefficiency on the part of any officer, enlisted man or civilian employee, either before, during, or after the recent disaster.

The court, therefore, in the light of all the evidence, cannot conscientiously fix the responsibility for this disaster upon any human being.

Recommendations

1. That immediate consideration be given to the following points and early action taken:

(a) To segregating cast TNT in bombs, depth charges, mines or other similar containers, from all other explosives or stores.

(b) To grounding of the metallic parts of magazines and their contents.

(e) To instructing magazine personnel to avoid fighting heavy fires in high explosive magazines.

(d) To making magazines, shell houses, and containers as non-inflammable as practicable, and of such construction as to eliminate forming heavy missiles in case of explosion.

(e) To locating dwellings clear of probable injury by fire explosions.

(f) To supplying ammunition depots with improved fire alarm and fire fighting equipment, and additional roads to provide access to fires.

International Newsreel

Aerial View of the southern end of Lake Denmark Area taken while magazines and shells were still exploding. Temporary magazines Nos. 8 and 9, the first buildings to "blow," were located near right foreground.

(g) To making distances between magazines adequate in future construction; and to preparing a table of distances to serve as a future guide, having in mind possible use of barricades or sub-surface storage.

2. That the Naval Ammunition Depot at Lake Denmark be rebuilt as an ammunition depot to accommodate such quantities of explosives as may be safely stored there, after a development plan has been approved by the Navy Department.

3. That Congress be asked at its next session to provide for two ammunition depots for the storage of high explosives. One of these depots to be within a radius of 1,000 miles from the Pacific Coast, and to be so located as to have convenient railroad facilities to the Los Angeles-San Diego Area, to the San Francisco Bay area, and to the Columbia River-Puget Sound area. The land provided to be either government owned land, or cheap barren land, covering an area of at least 100 square miles, and allowing an unoccupied safety zone of two miles.

The other depot in the East, of a similar area, centrally located, so as to have convenient railroad transportation to the Atlantic and Gulf ports, and to our East Coast Naval magazines.

4. That the Distinguished Medal be awarded to Capt. Otto C. Dowling, U. S. N., and the Navy Cross posthumously to Lieut. Com. Edward A. Brown (M. C.), U. S. N., Lieut. Herman C. Schrader, U. S. N., Chief Gunner Joseph M. Gately, U. S. N., Capt. Burwell H. Clarke, U. S. M. C., Corporal Frederick J. Rachford, U. S. M. C., Trumpeter Mason D. Eidson, U. S. M. C., Private Ralph V. P. Graham, Jr., U. S. M. C., Private John W. Monroe, U. S. M. C., Private Frank C. Weber, U. S. M. C., Private Virgel C. Barker, U. S. M. C., Private, First Class, Henry D. Mackert, U. S. M. C., Private Maurice R. Hardaker, U. S. M. C., Private, First Class, Orlando M. Alfson, U. S. M. C., Private Ernest Powell, U. S. M. C., Private John H. Little, U. S. M. C., and Harry Christian Brown, Pharmacist's Mate, First Class, U. S. N.

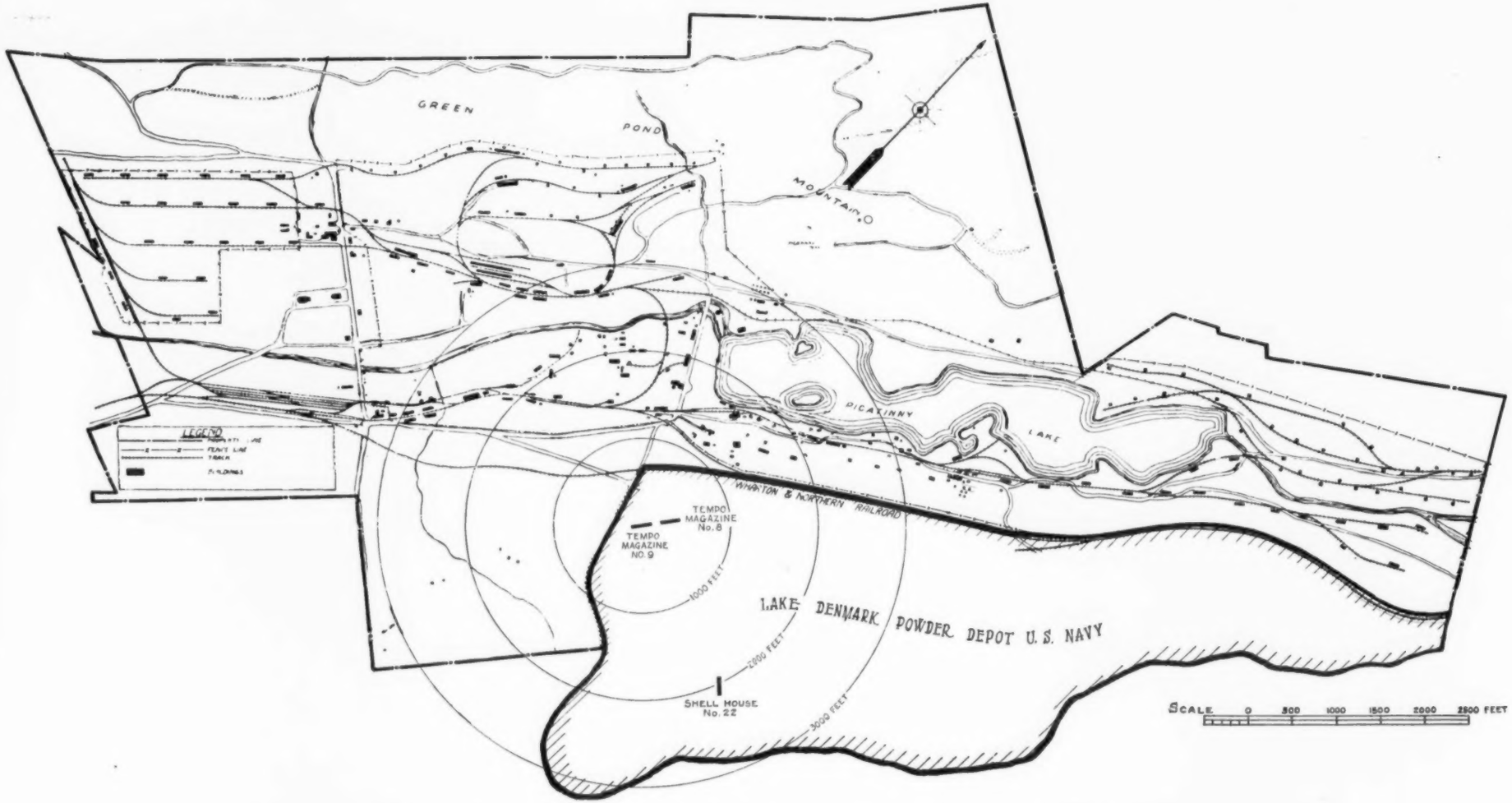
5. That the Navy Cross be awarded to Private Casmer M. Kensick, U. S. M. C.

6. That the highest possible appropriate recognition be awarded to Mr. Henry D. Wadhams, Chief Clerk of the Naval Ammunition Depot, Lake Denmark, N. J.

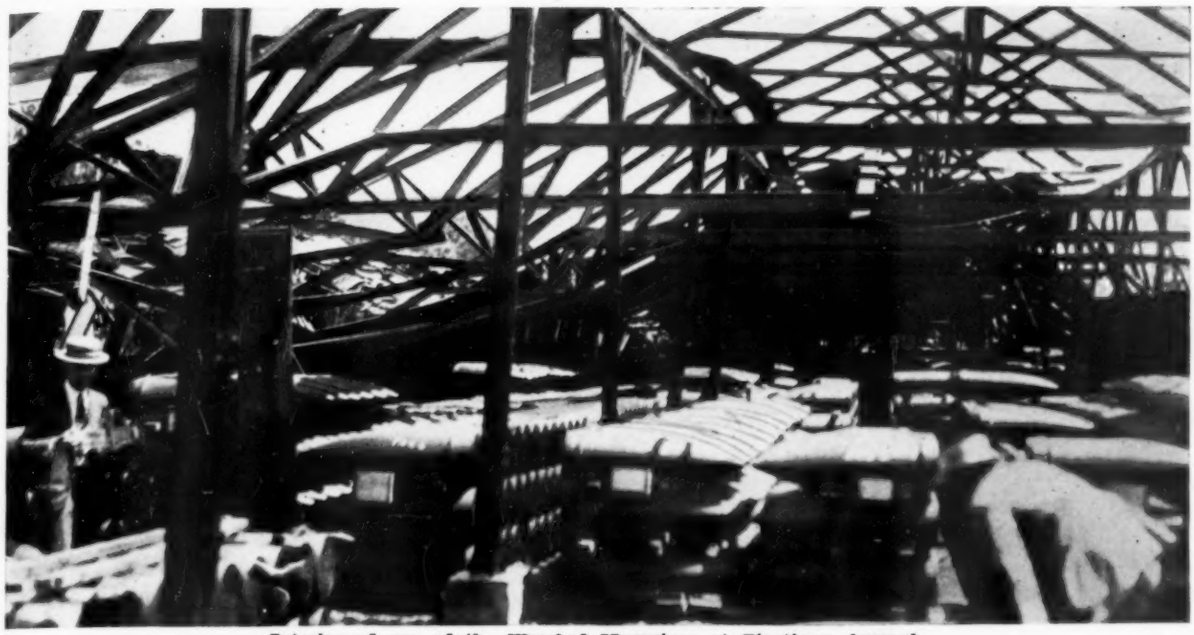
ROBERT E. COONTZ,
Rear Admiral, U. S. Navy, President.

STEPHEN C. ROWAN,
Captain, U. S. Navy, Judge Advocate.

Picatinny Arsenal---Lake Denmark, N. J., Area



The above map, drawn to scale, shows Picatinny Arsenal, the Army Ordnance establishment, enclosed with broken line. The Naval establishment, Lake Denmark Ammunition Depot, is shown bounded by the heavy unbroken line.



Interior of one of the Wrecked Magazines at Picatinny Arsenal.

The Lake Denmark Explosion—Its Effect on Picatinny Arsenal

Col. W. H. Tschappat, Ord. Dept., U. S. A.

BEGINNING at 5:20 P. M. on July 10, 1926, three major explosions occurred within a half hour, at the Naval Ammunition Depot at Lake Denmark, New Jersey. Newspaper accounts following this accident stressed the loss of lives which occurred at the scene of the explosion and the damage to property in the community of Mount Hope. Not much was said in the newspapers about the damage to property at Picatinny Arsenal, which lies in the valley below the Naval Depot and immediately adjacent thereto. A large number of the approximately 500 buildings at Picatinny Arsenal were nearer to the places where the major explosions took place than any building outside the government reservations.

The Chief of Ordnance and the Assistant Chief of Ordnance made an inspection at Picatinny Arsenal on Sunday, July 11th, the day following the explosion. At

Exterior of one of the Wrecked Magazines at Picatinny Arsenal.

A panoramic view of Lake Denmark Naval Ammunition Depot and a portion of Picatinny Arsenal after the explosions. ground is the

that time minor explosions were still taking place at the Naval reservation and further serious explosions were apprehended. Explosions of a minor nature continued until the following Wednesday.

Prompt action was taken by the Commanding General, 2nd Corps Area, to furnish troops to act as a guard and to assist in rescue work. Similar action was taken by the Marine Corps in connection with the Naval Depot. On July 13th, the Chief of Ordnance appointed a board of officers to investigate and report upon the damage resulting to Picatinny Arsenal from the explosions. The Board commenced its work on July 14th and completed it on August 5, 1926.

From information obtained from the report of the Naval Court of Inquiry, which has been made public, it appears that three major explosions occurred and that they were in Magazine No. 8, Magazine No. 9 and Shell House No. 22, in order. The explosion in Magazine No. 8 was really two explosions very close together. This was followed in about five minutes by the explosion of Magazine No. 9. The explosion in Shell House No. 22 occurred twenty minutes later than that in Magazine No. 9.

Office Quarters of the Loading Department, Picatinny Arsenal.

Picatinny Lake and the Army powder factory buildings are shown in the foreground. Surmounting the hill in the back-Naval Depot.

The geographical location of the magazines with reference to Picatinny Arsenal is shown roughly to scale in the sketch on page 130. The Picatinny Arsenal building nearest to Magazine No. 9 (the heaviest explosion), was a frame employees' stable at a distance of 850 feet; while the Arsenal building farthest from this explosion was a 30′ x 30′ hollow tile magazine in the upper storage area, containing miscellaneous samples of explosives, at a distance of 8,750 feet from Magazine No. 9. Needless to say, the stable was completely demolished, while the damage to the magazine consisted of a broken roof truss and minor items.

It may be stated that every building at Picatinny Arsenal was damaged to some extent by the explosions. It may also be stated that while many missiles were thrown into the Arsenal by the explosions, including hundreds of stones from the earth underneath the magazines which exploded, very little damage was done by such missiles, when compared with the damage done by the explosion waves. Included among the missiles were pieces of railroad rails, pieces of roof trusses, and loaded projectiles of various calibers up to 14 inches. It is interesting to note that there were some explosions of loaded projectiles after impact. Since the fuze could hardly have been armed and the

The Chemical Research Laboratory Building, Picatinny Arsenal.

impact was not severe enough to cause explosion by shock, it appears necessary to look for another explanation for such explosions. The most reasonable one seems to be that these projectiles had been highly heated by fire just before being thrown by the explosion and that the heat in the metal parts did not penetrate to the explosive sufficiently to set it off until after impact. Projectiles and other missiles were found at a distance of considerably over a mile from their probable origin.

As before stated, the principal damage to buildings was done by the explosion waves. The amount of damage depended of course upon the distance from the explosion, the type of building and the conformation of the intervening ground. Very few of the buildings were protected by natural barricades to any great extent. However, the protective effect of an intervening rise of ground was noted to some extent in some of the magazines of the upper storage area. In general, though, the explosion wave seemed able to go around rather sharp corners.

Throughout the Arsenal it was evident that the parts of buildings most subject to damage could be placed about in the following order: (1) Window glass and window sash; (2) plaster; (3) doors; (4) roofs, rafters, purlins and roof trusses; (5) metal wall sheating; (6) tile walls; (7) frame walls and partitions; (8) brick walls; (9) stucco over metal lath on frame; (10) stone walls; (11) reinforced concrete walls.

Wired glass was no better than plain glass in its resistance to these waves, but it broke in larger pieces. Plaster held better on metal than on wooden lath. Roofs seemed to be the most vulnerable parts of buildings. If the roof covering or sheathing was strong, the purlins and trusses were badly smashed, even though they were of heavy steel construction. If the roof covering was easily breakable, much less damage was done to trusses and purlins. A light roof covering would seem to be very desirable in buildings exposed to this type of explosion wave. In looking over the damage to the Arsenal, the breakage of roofs and trusses forms probably the largest single item. Breakage of roofs and trusses was frequently responsible for cracking or knocking down of side walls, as the breakage of the tension members of the truss caused spreading of the truss and side thrust on walls.

It will be noted that tile walls were more subject to damage than frame walls. This is probably on account of the action of the roof trusses just noted which readily cracked tile walls, while in many cases it only slightly displaced frame walls.

Brick walls stood up well except where cracked or thrown over by the giving away of the roof trusses. All walls were less damaged in buildings containing many, or large, windows. In the case of the hollow tile magazines it was also noted that less damage was done to those nearly filled than to those almost empty. In some cases this was due to the fact that piles of boxes or other articles supported the roof trusses and prevented them from spreading in such a manner as to push over the walls, but it is also thought that part of this effect may be due to the presence of less air in these magazines with less expansion at the time when the vacuum wave passed.

A few frame buildings with stucco on metal lath stood up remarkably well as far as wall covering is concerned. Even though such walls were displaced as a whole, very few cracks appeared in the stucco. It is understood, however, that the stucco on these buildings was trowelled on the inside as well as on the outside of the metal lath and that it contained a large proportion of cement.

There were a number of reinforced concrete safety walls at various locations in the Arsenal. All of these showed remarkable resistance to the explosion wave. None was thrown over, although some in the powder factory were not over 1,500 feet from the source of the explosion.

In general, window glass was thrown inward and walls were thrown outward. The reason for the latter, however, was partly the action of the roof trusses as above described. Where buildings completely collapsed, as in the case of some near the scene of the explosion, some of the walls fell inward but in a direction away from the source of the explosion.

It is a rather remarkable fact that while the damage to the buildings was serious, and extended throughout the Arsenal, the damage to machinery and equipment was relatively slight and consisted mostly of injury by missiles and destruction by fire. The chemical laboratory and the service storehouse, including all their contents, were completely destroyed by fire after they had been wrecked by the explosion. The smoke stacks and breeching at the power house were damaged by the explosion waves; otherwise, the damage to boilers, engines, pumps, and the complicated piping of the power house, was slight and was practically that done by the falling walls. The very long length of overhead steam piping throughout the Arsenal was very slightly damaged, even where it was close to the source of the explosion. This pipe line was hit in a number of places by missiles.

The Board which investigated the damage at Picatinny Arsenal found that the cost of temporary repairs necessary to resume operations in all departments except the manufacture of "pyro" is approximately $287,000. The total damage to the Arsenal as determined by the replacement cost of buildings and equipment is approximately $1,265,000. The Board also made recommendations as to relocation of certain activities, which will receive consideration when plans for permanent reconstruction are studied.

Organization of the New York Ordnance District

THE publication of a formal organization order by any unit headquarters marks a definite point in the development of the unit. Hence the comprehensive statement of the problem of industrial mobilization in the New York Ordnance District as well as the outline of organization and procedure for its solution as contained in Circular No. 4, under date of April 6, 1926, which follows, deserves the attention and interest of industrial preparedness advocates.

This circular is something more than a routine order. It is a substantial contribution to industrial mobilization literature which will be read with interest by all who are following the specific development of procurement planning in this country and especially by the Ordnance Reserve Officers and personnel of Ordnance Reserve Plants of the New York District.

The importance of Ordnance Reserve Plants is very appropriately recognized throughout the circular, and it is to these plants that we would call particular attention and emphasize the large part which they must play in any scheme of national defense.

We all understand fairly well the three-in-one personnel Army of the United States; we accept the logic of the system of having a highly trained professional Regular Army ready to serve at a moment's notice when need arises not only, but actively engaged in training and developing the equally important National Guard and Organized Reserve components. The Guard is primarily an agency of the State from which it comes with both officers and men serving in the dual capacity of peaceful civilians and professional soldiers, while the Organized Reserves are essentially officers with special military training to fit them for emergency service.

Can we not make a parallel classification of our ordnance manufacturing plants by giving to our ordnance arsenals the Regular Army portion and assigning them to mission of immediate production whenever ordnance is required in peace or war, training personnel, and serving as professional and technical information centers for the other two classes of establishments—ordnance commercial plants and ordnance reserve plants?

Ordnance commercial plants like the National Guard must play a dual role of producing ordnance in peace and war and at the same time maintain a stable position in the industrial fabric of the nation; while ordnance reserve plants are those plants which, like the Organized Reserve Officers, are only brought into action to meet the great emergency of war.

The success of the system is of course dependent upon the continued development and growth of knowledge of the ordnance problem and deliberate intelligent effort toward its solution. Experience of the World War proved the value of the present system of decentralized procurement upon which the Ordnance Districts are based. And since time is of the essence of all preparedness, it follows, we take it, that these decentralized procurement agencies are that much closer to their goal when the machinery of organization is ready to function. The Ordnance Districts today are eminently well prepared in this respect. They are directed by civilian experts who know the Ordnance problem in all its complexities and who understand fully the possibilities of their respective districts. They are manned by a corps of executives whose knowledge, experience and zeal well fit them for the tremendous responsibilities of the mass procurement of Ordnance.

Col. James L. Walsh and his associates, of the New York Ordnance District, in the publication of this order have given us their conception of the mission of an Ordnance District and we commend it to our readers for study and analysis.

Commenting upon the scope and value of this organization order, which Circular No. 4 is, in effect, Mr. John C. Jones, Chief of the Philadelphia Ordnance District, whose excellent service in that capacity during and since the World War is well known, said:

"It reflects great credit on Colonel Walsh and his associates, for I believe it to be the most comprehnsive outline of the functions and duties of an Ordnance District Office that has been made. The introductory chapters, representing the Basic Considerations, captioned, respectively, 'World War Experience,' and 'The Ordnance Problem of Today,' are to be especially commended for their clear statement of the conditions which prevailed during the Great War, and which confront the Ordnance Department today.

"Each District Office should give the fullest consideration to all the sub-divisions outlined in the set-up and in the chart, which represent an able analysis of District Ordnance functioning, in order to correct and plan their staffs and organizations in accordance with their local requirements and conditions.

"I am very glad indeed that this systematic outline and plan has been published, and is to be made available to those who in the years to come will follow after us."

Here then is an effective contribution to our national defense plans. It is to be hoped that the publication of Circular No. 4 in these pages will assist those who are giving so generously of their time and effort to Industrial Preparedness throughout the country and that constructive criticism and discussion of the order will result.

WAR DEPARTMENT
HEADQUARTERS NEW YORK ORDNANCE DISTRICT
ARMY BUILDING, 39 WHITEHALL ST.
NEW YORK CITY

ADVISORY BOARD:
ELBERT H. GARY, CHAIRMAN

P. E. CROWLEY	SAMUEL MC ROBERTS
J. M. DAVIS	DWIGHT W. MORROW
JOHN I. DOWNEY	SEWARD PROSSER
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JAMES L. WALSH, DISTRICT CHIEF
C. E. DAVIES, SECRETARY

April 6, 1926.

Circular No. 4

NOTES ON INDUSTRIAL MOBILIZATION NEW YORK ORDNANCE DISTRICT.

I. BASIC CONSIDERATIONS.

WORLD WAR EXPERIENCE

1. When war was "*thrust upon* the United States"—to use the language of the Joint Resolution of Congress, approved April 6, 1917—, the manufacturers of the Metropolitan New York industrial area were confronted, although few realized it, with the vitally important task of furnishing the combat forces with fighting equipment to an aggregate value of $750,000,000. The tremendous industrial effort involved in meeting the Army's demands for arms and ammunition eventually required the training and employment at new and unfamiliar tasks of one-third of all the factory workers of the district. The problem was not merely to expand along familiar lines, but to transform existing facilities and to construct new facilities for the manufacture of strange implements of war, most of which had never even been heard of by those suddenly assigned the duty of producing them.

2. The radical process of transformation which ensued involved the conversion of plants and the diversion of personnel from the manufacture of printing presses to gun-carriages; from sewing machines to hydropneumatic recuperators for artillery; from fire hydrants to 75-millimeter shells; from water meters to supersensitive fuzes; from tin cans to shell forgings; from electrical fixtures to trench mortar shell; from phonographs to bomb sights; from piano hardware to drop-bomb mechanisms; from typewriters to pistols; from corsets to feed bags; from shirtwaists to bandoliers; from lingerie to cartridge bags; etc., etc.

3. During the World War, the entire ordnance program required executive personnel totalling 11,000 commissioned officers—only 97 were available on April 6, 1917. As a result, fifteen months were required to complete the organization of the New York Ordnance District, which, by the time the Armistice was signed, employed a headquarters staff of four thousand persons occupying 77,000 square feet of office space to properly handle the government's interests in the 3,500 contracts then in process of execution.

4. The delay in getting under way was due, in large measure, to the fact that ordnance, consisting solely of materials of war, is not produced commercially in time of peace. Therefore, the knowledge necessary to design and manufacture it is not developed automatically in any of our peace activities. Yet, in time of war, it requires a preponderant share of our industrial effort. Appropriations and contract authorizations for war purposes totalled 32 billions of dollars—over 15 billions were to be devoted to the manufacture of ordnance. Eight thousand factories, employing four million persons, devoted their entire energies toward producing ordnance for our first three and a half million men in the World War. The Army Ordnance effort consumed labor and raw materials at a *monthly* rate greater than the total cost of the *entire ten years'* construction period of the Panama Canal.

5. Mere magnitude alone would make the Ordnance problem paramount in any consideration of preparedness against war, but practically alone among all our wartime industrial activities, it is unfortunately complicated by the inherent difficulty of having no parallel peace-time activity to stimulate its development and furnish a quickly available auxiliary personnel for the expansion of the permanent personnel in emergency. Yet our forces must have Ordnance to make them effective from a military point of view, and this Ordnance must be finished before combat training can begin. Obviously then, *the production of Ordnance constitutes the critical and controlling factor of the whole problem of National Defense.*

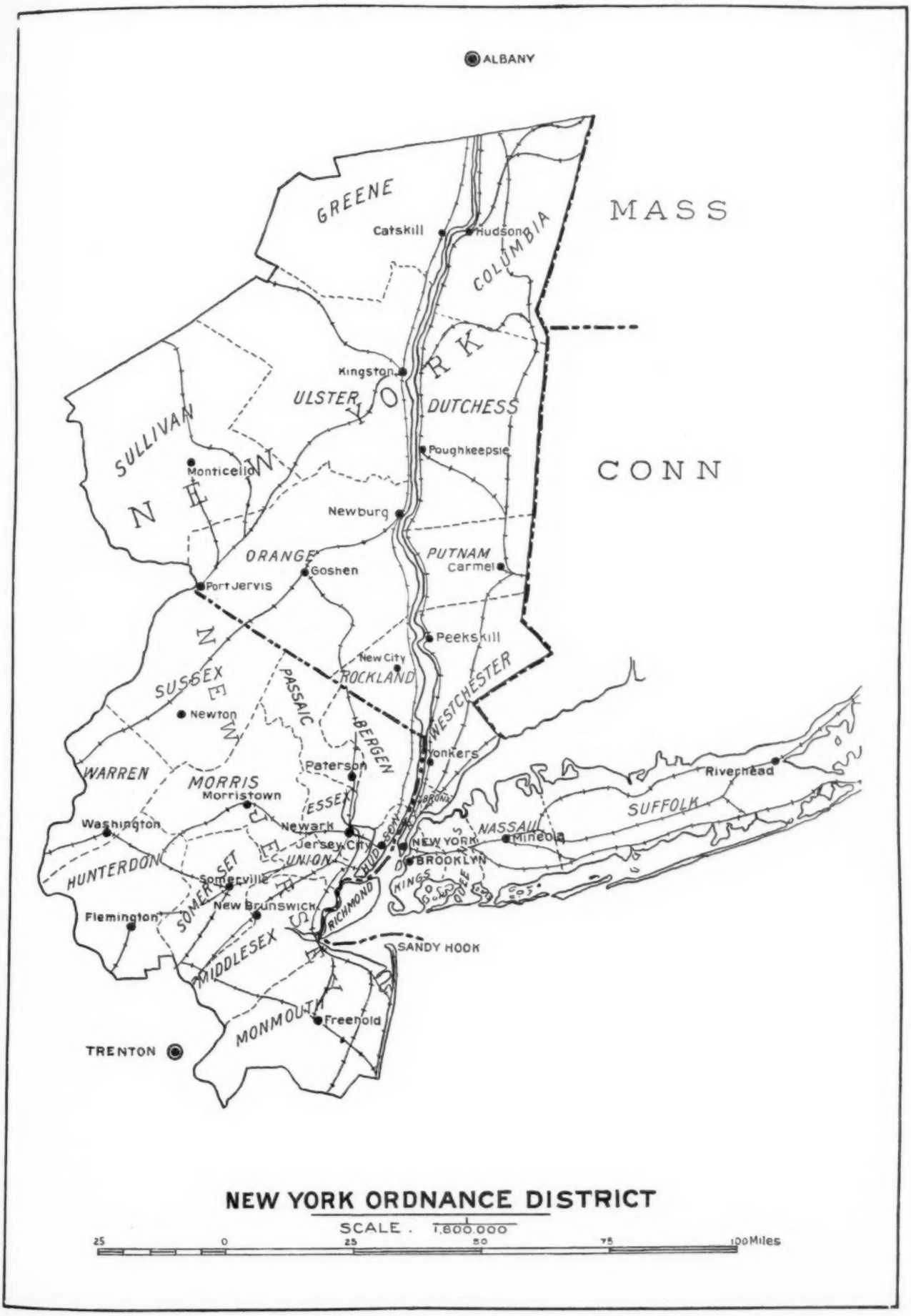
THE ORDNANCE PROBLEM OF TODAY

1. In considering preparation for National Defense, it becomes at once apparent that

(a) Training in the *use* of arms, and

(b) Training in the *manufacture* of arms

must be artificially stimulated in times of peace, inasmuch as these two phases of preparedness are not part of the ordinary peace-time life of the Nation. Stimulation of training in the use of arms is attained through the medium of such established institutions as the Regular Army, the



NEW YORK ORDNANCE DISTRICT

SCALE. 1/1,800,000

25 0 25 50 75 100 Miles

National Guard, the six armies of the Organized Reserves, the Reserves Officers' Training Corps Units at colleges and private military academies, Civilian Military Training Camps, National Rifle Matches—all supported by Federal appropriations, which are considered to have been wisely expended provided only that the personnel involved achieves, either individually or collectively, a reasonable degree of proficiency in the *use* of arms.

2. With equal force, it could be urged that, if the government feels justified in expending considerable sums merely to insure that a certain proportion of its citizens shall know how to *use* arms in its defense, it should, according to the same logic, stand ready to make the corresponding appropriations necessary to insure that the much greater proportion of its citizens required to produce this material shall likewise know how to *manufacture* the arms and their ammunition, which obviously must be completed before they can be used.

3. Unfortunately, public opinion is not yet sufficiently appreciative of the importance of keeping alive a widespread knowledge of the industrial processes incident to the art of ordnance manufacture. Certainly, the time has not yet arrived when Congress will authorize expenditure of public funds to the end, merely, that men shall have acquired the knowledge necessary to *manufacture* rifles, although it is satisfied with expenditures which yield no other return to the government than that certain men have learned how to *use* rifles. This, notwithstanding that it is as much easier to teach a man how to use a rifle as compared with teaching him how to make it, as it manifestly is to teach motorists how to drive automobiles as compared with teaching mechanics how to manufacture them.

4. It is true that government arsenals keep alive knowledge of ordnance manufacture on a laboratory basis, but the insufficiency of this can be appraised from the fact that the World War production of the New York Ordnance District alone over a period of but eight months would have kept busy every arsenal in the country for approximately *fifteen years*.

5. However, the preponderant importance of ordnance production as the crux of the whole problem of preparation for National Defense is becoming, slowly but increasingly, apparent through analysis of our most recent experience. Already, standard types have been adopted for each article of ordnance equipment; quantities and schedules of deliveries have been determined with the greatest possible exactitude; and quotas for emergency production have been assigned the various districts into which the entire country has been divided. The next step, now under way, is the allocation by "tentative orders" of portions of the district quota to specific plants as a preliminary to having each factory draw up detailed plans for prompt production of its allocated items in the event of an emergency.

6. In the area corresponding to the New York, Buffalo and Philadelphia Ordnance Districts, 131 Regular Army Officers are at present giving full-time to problems connected with the emergency mobilization of man-power or the use of arms, while but 4 are available for solving problems related to the emergency mobilization of munition power or the *manufacture* of arms. Until this disparity is corrected, the National Defense program as a whole is obviously out of balance to a critical degree. Under the conditions which now obtain, it is necessary to offset the deficiency in full-time Regular Officers by utilizing the part-time services of Reserve Officers on a volunteer basis. Accordingly, special effort must be made to recruit and train Reserve Officers to handle the government's interests, and to cooperate with manufacturers in completing the necessary factory plans for emergency production of ordnance.

7. The amount of time which Reserve Officers can devote to this work is limited, and it will probably never be possible, in times of peace, to assemble the entire commissioned personnel on any single occasion, so that officers can learn their own duties and their places in the whole organization. To overcome this handicap, it is necessary to break down the general problem into its elements, to assign officers to the study of particular phases of the problem, and to correlate their activities through the medium of a detailed organization chart and explanatory text.

8. Although the World War yielded valuable experience in the organization and administration of Ordnance Districts under war-time conditions, the organization of an Ordnance District *during peace time* so that it will begin to function promptly and effectively upon the outbreak of war, is, in some respects, a quite different problem. During the World War, practically all contracts were negotiated and signed in Washington, after which they were sent to the proper Ordnance District for execution. Under the War Department's announced policy of decentralization determined upon as a result of World War experience, the important function of "procurement" is delegated almost entirely to the various Ordnance Districts, in addition to all of the functions they exercised during the World War. The new conception of an Ordnance District makes District Headquarters, in effect, a complete self-contained unit exercising within its territorial limits, all the functions of the Office of the Chief of Ordnance in Washington—with the single exception of the engineering function of determining the designs and specifications for standard articles of ordnance equipment.

II. THE ORDNANCE DISTRICT.

1. To make adequate provision for industrial mobilization, and, if war shall unhappily come, to carry out our production program, there is but one source to which the nation can turn for necessary support. The industrial war load of the United States must be borne by the industries of the United States, and the leaders of peace-time industry—its executives and its engineers—must constitute the real support of whatever measure of industrial preparedness is attainable in peace times by the War Department under the supervision of the Assistant Secretary of War. To make industrial preparedness effective as insurance for our national existence, it is essential that it have the whole-hearted support of the leaders of our nation's industry expressing itself through the medium of an effective organization.

2. Under the authority of section 5-a of the Act of Congress, approved June 3, 1916 (National Defense Act), as amended by the Act of Congress, approved June 4, 1920, which provides that—

> "The Assistant Secretary of War, under the direction of The Secretary of War, shall be charged with supervision of the procurement of all military supplies and other business of the War Department pertaining

thereto, and the assurance of adequate provision for the mobilization of material and industrial organizations essential to war-time needs,"

the Chief of Ordnance, with the approval of The Assistant Secretary of War, has established the New York Ordnance District, charged with the procurement, production, inspection of, and payment for such articles of ordnance as may be allocated by proper authority for manufacture within the industrial area of Metropolitan New York in the event of actual or threatened emergency.

3. The District as established embraces New York, Bronx, Queens, Kings, Richmond, Nassau, Suffolk, Rockland, Westchester, Orange, Putnam, Dutchess, Sullivan, Ulster, Green and Columbia Counties of the State of New York; Bergen, Passaic, Sussex, Essex, Morris, Union, Warren, Hunterdon, Somerset, Middlesex, Monmouth and Hudson Counties of the State of New Jersey (Ordnance Office Order No. 404, dated May 17, 1922). A considerable number of manufacturing plants within this area have been assigned by The Assistant Secretary of War for the manufacture of various articles of Ordnance, including Artillery, Rifles, Pistols, Machine Guns and Ammunition therefor; Fire Control Instruments, Caissons, Limbers and Mobile Repair Shops; Airplane Bombs and Fuzes; Tanks, Tractors and Trailers; and Miscellaneous Ordnance Stores, Supplies and Accessories.

4. The industrial resources of the District which have been assigned by The Assistant Secretary of War for the production of ordnance in the event of an emergency, are organized as follows:

District Headquarters

The Advisory Board — The Claims Board

The Ordnance Reserve Plants

The potential contribution of the Ordnance District toward meeting a possible national emergency lies wholly in its Ordnance Reserve Plants, i. e., commercial factories, which have been assigned by The Assistant Secretary of War to produce ordnance in emergency, and which have indicated a willingness to cooperate with the government in effecting a reasonable degree of Industrial Preparedness. District Headquarters, the Advisory Board and the Claims Board have no other good reason for existence than to assist this potential strength to be exerted effectively and efficiently for the National Defense.

5. The primary function of the New York Ordnance District is to organize the industries of the District *in readiness* to produce ordnance of proper quality, in proper quantity, at the proper time, as determined by higher authority—all to the end that a threatened emergency may be averted or an existing emergency terminated on a satisfactory basis within a minimum of time. The problem of securing complete social, political and economic justice for all concerned, can be considered only insofar as it affects attainment of maximum utilization of the resources of the District.

III. DISTRICT HEADQUARTERS.

FUNCTIONS

1. DISTRICT HEADQUARTERS (as distinguished from the entire Ordnance District) is an instrumentality of the United States Government, organized in furtherance of the approved policy of decentralization, to make known and interpret the Army's requirements for ordnance; to allocate these requirements to the specific factories best equipped to meet pre-determined production schedules; to assist these factories to prepare in time of peace to meet their specific war-time allocations; in the event of an emergency, to facilitate the transition from commercial status, expedite the production of ordnance, and secure just and adequate compensation from the government for all concerned; and, when the emergency has passed, to assist in the return of industry to its peace-time activities with the least possible dislocation of its economic structure.

2. In exercising these general functions, it is fundamentally important that representatives of the government avoid interference with private initiative and limit their activities to helping the manufacturer to effectively carry his share of the industrial effort. Supervision to an unnecessary degree, paralyzes production instead of stimulating it; and arbitrary exercise of governmental authority destroys the spirit of aggressive, intelligent teamwork essential to success in the tremendous problems devolved upon the District upon the outbreak of war.

3. In order to avoid the possibility of conflicting instructions being given the manufacturer in the name of the government, from the initial negotiations in regard to contracts until final payment is made, all contact between the government and manufacturers whose plants have been allocated for production of ordnance in the event of an emergency, will be made through District Headquarters, whether or not work for other government bureaus is undertaken in addition to the manufacture of ordnance. In this way, it is hoped that the confusion and congestion in Washington which characterized the first year of the World War will be, in great part, avoided.

4. In times of peace, the principal functions of District Headquarters are, more specifically—

(a) To survey existing plants in order to determine availability for manufacture of ordnance in emergency.

(b) To place "Tentative Orders" for production of such articles as have been allocated to the District as its quota of the entire Ordnance program.

(c) To assist manufacturers in the preparation of factory plans for emergency production.

(d) To determine upon sites and construction plans for such new plants as may be required for the manufacture of such articles as cannot reasonably be expected to be manufactured in plants already in existence within the District.

(e) To recruit, examine, commission, assign to specific responsibilities and train for proper performance of both peace-time and war-time duties, all personnel required to fulfill the functions of the District Headquarters as prescribed from time to time in Regulations and Orders.

5. In time of actual or threatened emergency, the principal functions of District Headquarters are, more specifically—

(a) To confirm and put into effect specific "Tentative Orders" under instructions of higher authority.

(b) To assist manufacturers to attain prompt production of articles previously allocated to each plant.

(c) To start construction of such new plants as may be deemed necessary.

(d) To inspect completed units or components in process and upon completion.

(e) To accept satisfactory material on behalf of the government.

(f) To compensate the manufacturer equitably for the service rendered the government.

(g) To direct shipment of accepted material to the combat forces.

(h) To be prepared to assist in the demobilization of industry.

6. In its broadest aspect, the whole problem of organizing commercial factories for the production of ordnance in emergency hinges, at the present time, upon two factors:

(a) The training of Ordnance Reserve Officers to properly present the government's requirements;

(b) The education of Ordnance Reserve Plants to meet the government's requirements.

It is highly desirable that these two phases be carried along simultaneously, utilizing to the full, every opportunity for mutual education. The important function of "procurement"—at least insofar as survey of plants allocation of requirements and placing of tentative orders is concerned—is available for the training of Ordnance Reserve Officers. By assigning certain officers to assist in the completion of factory plans for emergency manufacture, additional training, in the equally important function of "production," can be imparted. Due to the fact that but one or two Regular Army Officers are available for assignment to the District and that even they are subject to frequent change, it seems desirable that their time should be very largely devoted to the instruction of Reserve Officers, with a view to having the latter carry on the peace-time work of the District to the greatest possible extent.

7. Under these conditions, and in order to permit easy transition from peace-time training to war-time operation, it appears to be axiomatic that the peace organization and the war organization of District Headquarters should be identical in all respects, that peace-time assignments of officers should be their war assignments on being called to active duty, and that each key position in the organization should have two officers regularly assigned to it during peace times. In practice, it has been found highly desirable to provide for an Assistant District Chief, Assistant Chiefs of Engineering, Administration, Manufacture and Facilities, and, also, Assistant Chiefs of the principal operating Divisions.

8. Reserve Officers, unless called to active duty, receive no pay from the government, and, at present, Federal appropriations are sufficient only to cover active duty of a few officers for 15 days in each year. Whatever they can do for the government must be done almost entirely at their own expense and in such leisure time as may be available after taking care of the demands of their private business. Under these circumstances, it becomes necessary to confine the Reserve Officer's assignment to comparatively narrow limits in order to avoid making inordinate demands upon his time. If assigned merely to "Administration," he will soon lose interest. If assigned to "Contract Division, Administration Service," however, his possible war duty is brought more distinctly into focus, his interest is aroused and his peace-time training takes on a new and greater significance. If, in the course of time, he is asked to pass upon the legality of particular features of an actual contract under consideration by the Chief of the Artillery Division, for instance, he begins to feel that his time spent in training is of real value to other officers of the District and a definite contribution toward the National Defense. Results obtained in the New York Ordnance District during the last two winter training seasons seem to warrant the continuation and extension of operating along the lines indicated.

9. The following organization of District Headquarters has been determined upon as meeting the conditions imposed after an exhaustive study of the orders promulgated by the Chief of Ordnance in organizing the Ordnance Office during the World War, considered in connection with a detailed review of "The History of the New York Ordnance District, 1917-1919."

INTERIOR ORGANIZATION

The District Chief is, under appointment of the Chief of Ordnance, "charged with the procurement, production and inspection of such ordnance material as may be assigned to the New York Ordnance District in the event of an emergency," and within the District, is vested with the full authority and responsibility of the Chief of Ordnance, excepting only final decision upon all questions of design or specification of standard articles of ordnance material.

In the execution of these general duties, he has delegated responsibility for initiating and completing necessary action to the component units of District Headquarters as set forth below. He reserves for his personal attention all matters of general policy affecting the external relations of the District as a whole—including all communications with higher or coordinate authority except correspondence of a purely informative or routine nature; and all relations with the Advisory Board and the Claims Board.

The Assistant District Chief is charged with executive supervision of all activities *within* the District, particularly those necessary to stimulate and coordinate the work of the four main operating Services.

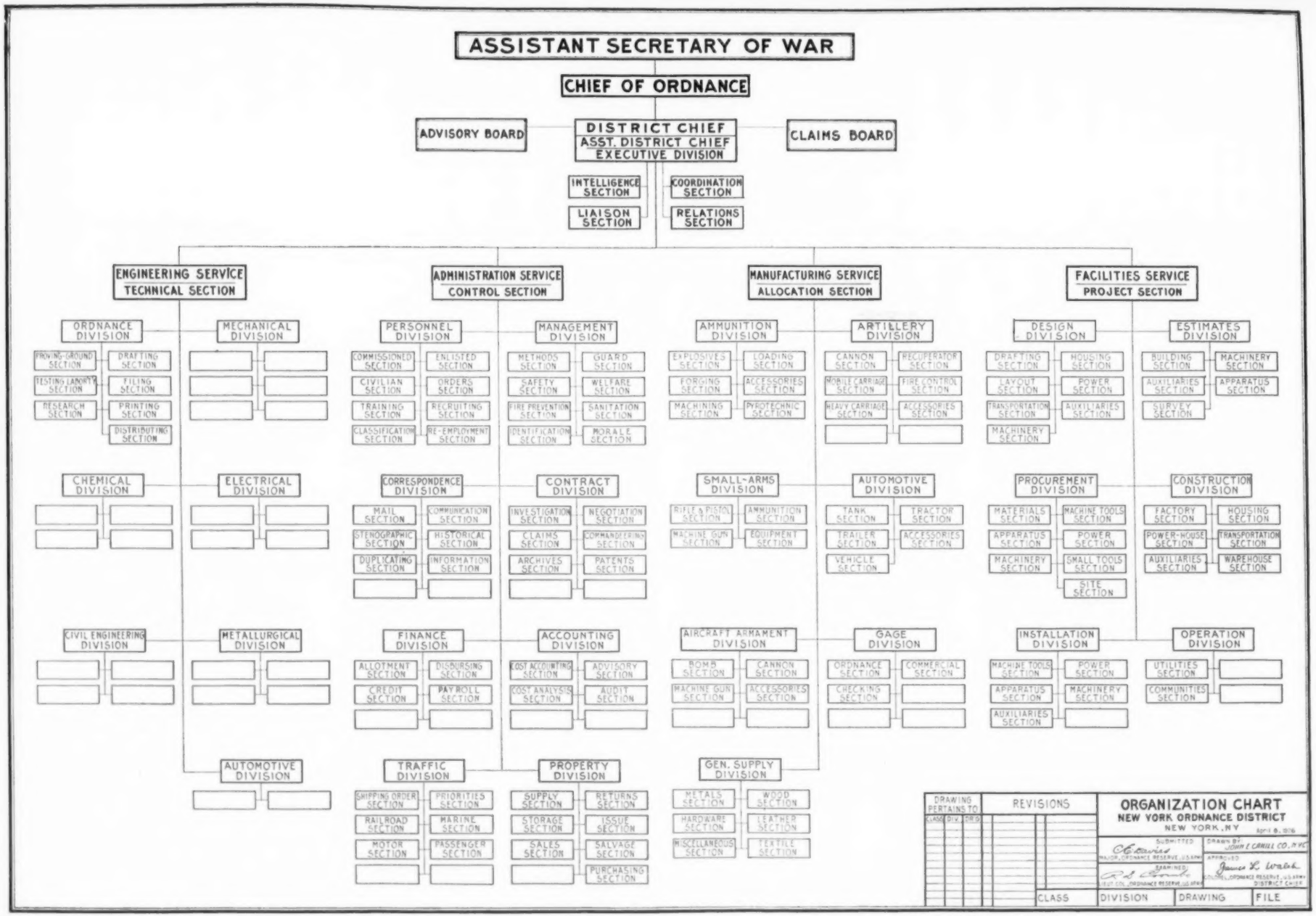
A. Executive Division

The Executive Division—comprises the personal offices of the District Chief and the Assistant District Chief and four Sections with duties as follows:

1. *Intelligence Section*—
   (a) Organizes and supervises counter-espionage activities within the District in cooperation with the Military Intelligence Division of the General Staff, and the Department of Justice.
   (b) Investigates, under specific instructions of the Assistant District Chief, alleged irregularities within the District, and recommends corrective action where necessary.
   (c) Receives, answers and files all confidential communications.

2. *Liaison Section*—
   (a) Maintains contact with other governmental bureaus operating within the District in order to facilitate coordinated effort.
   (b) Receives and assists representatives of allied Governments in their relations with the District.

3. *Coordination Section*—
   (a) Consolidates periodic reports of District's activities for the information of the District Chief and higher authority.


ASSISTANT SECRETARY OF WAR
CHIEF OF ORDNANCE
ADVISORY BOARD
DISTRICT CHIEF
ASST. DISTRICT CHIEF
EXECUTIVE DIVISION
CLAIMS BOARD
INTELLIGENCE SECTION
COORDINATION SECTION
LIAISON SECTION
RELATIONS SECTION
ENGINEERING SERVICE
TECHNICAL SECTION
ADMINISTRATION SERVICE
CONTROL SECTION
MANUFACTURING SERVICE
ALLOCATION SECTION
FACILITIES SERVICE
PROJECT SECTION
ORDNANCE DIVISION
PROVING GROUND SECTION
TESTING LABORATORY SECTION
RESEARCH SECTION
DRAFTING SECTION
FILING SECTION
PRINTING SECTION
DISTRIBUTING SECTION
MECHANICAL DIVISION
PERSONNEL DIVISION
COMMISSIONED SECTION
CIVILIAN SECTION
TRAINING SECTION
CLASSIFICATION SECTION
ENLISTED SECTION
ORDERS SECTION
RECRUITING SECTION
RE-EMPLOYMENT SECTION
MANAGEMENT DIVISION
METHODS SECTION
SAFETY SECTION
FIRE PREVENTION SECTION
IDENTIFICATION SECTION
GUARD SECTION
WELFARE SECTION
SANITATION SECTION
MORALE SECTION
AMMUNITION DIVISION
EXPLOSIVES SECTION
FORGING SECTION
MACHINING SECTION
LOADING SECTION
ACCESSORIES SECTION
PYROTECHNIC SECTION
ARTILLERY DIVISION
CANNON SECTION
MOBILE CARRIAGE SECTION
HEAVY CARRIAGE SECTION
RECUPERATOR SECTION
FIRE CONTROL SECTION
ACCESSORIES SECTION
DESIGN DIVISION
DRAFTING SECTION
LAYOUT SECTION
TRANSPORTATION SECTION
MACHINERY SECTION
HOUSING SECTION
POWER SECTION
AUXILIARIES SECTION
ESTIMATES DIVISION
BUILDING SECTION
AUXILIARIES SECTION
SURVEY SECTION
MACHINERY SECTION
APPARATUS SECTION
CHEMICAL DIVISION
ELECTRICAL DIVISION
CORRESPONDENCE DIVISION
MAIL SECTION
STENOGRAPHIC SECTION
DUPLICATING SECTION
COMMUNICATION SECTION
HISTORICAL SECTION
INFORMATION SECTION
CONTRACT DIVISION
INVESTIGATION SECTION
CLAIMS SECTION
ARCHIVES SECTION
NEGOTIATION SECTION
COMMANDEERING SECTION
PATENTS SECTION
SMALL-ARMS DIVISION
RIFLE & PISTOL SECTION
MACHINE GUN SECTION
AMMUNITION SECTION
EQUIPMENT SECTION
AUTOMOTIVE DIVISION
TANK SECTION
TRAILER SECTION
VEHICLE SECTION
TRACTOR SECTION
ACCESSORIES SECTION
PROCUREMENT DIVISION
MATERIALS SECTION
APPARATUS SECTION
MACHINERY SECTION
MACHINE TOOLS SECTION
POWER SECTION
SMALL TOOLS SECTION
SITE SECTION
CONSTRUCTION DIVISION
FACTORY SECTION
POWER-HOUSE SECTION
AUXILIARIES SECTION
HOUSING SECTION
TRANSPORTATION SECTION
WAREHOUSE SECTION
CIVIL ENGINEERING DIVISION
METALLURGICAL DIVISION
FINANCE DIVISION
ALLOTMENT SECTION
CREDIT SECTION
DISBURSING SECTION
PAYROLL SECTION
ACCOUNTING DIVISION
COST ACCOUNTING SECTION
COST ANALYSIS SECTION
ADVISORY SECTION
AUDIT SECTION
AIRCRAFT ARMAMENT DIVISION
BOMB SECTION
MACHINE GUN SECTION
CANNON SECTION
ACCESSORIES SECTION
GAGE DIVISION
ORDNANCE SECTION
CHECKING SECTION
COMMERCIAL SECTION
INSTALLATION DIVISION
MACHINE TOOLS SECTION
APPARATUS SECTION
AUXILIARIES SECTION
POWER SECTION
MACHINERY SECTION
OPERATION DIVISION
UTILITIES SECTION
COMMUNITIES SECTION
AUTOMOTIVE DIVISION
TRAFFIC DIVISION
SHIPPING ORDER SECTION
RAILROAD SECTION
MOTOR SECTION
PRIORITIES SECTION
MARINE SECTION
PASSENGER SECTION
PROPERTY DIVISION
SUPPLY SECTION
STORAGE SECTION
SALES SECTION
RETURNS SECTION
ISSUE SECTION
SALVAGE SECTION
PURCHASING SECTION
GEN. SUPPLY DIVISION
METALS SECTION
HARDWARE SECTION
MISCELLANEOUS SECTION
WOOD SECTION
LEATHER SECTION
TEXTILE SECTION
DRAWING PERTAINS TO
CLASS DIV. ORG.
REVISIONS
ORGANIZATION CHART
NEW YORK ORDNANCE DISTRICT
NEW YORK, N.Y.
April 8, 1926
SUBMITTED
MAJOR, ORDNANCE RESERVE, U.S.ARMY
DRAWN BY
JOHN E. CAHILL CO., N.Y.C.
APPROVED
COLONEL, ORDNANCE RESERVE, U.S.ARMY
DISTRICT CHIEF
EXAMINED
1ST LT., ORDNANCE RESERVE, U.S.ARMY
CLASS
DIVISION
DRAWING
FILE

(b) Secures expeditious action on all matters involving two or more of the operating Services.
(c) Correlates joint activities of the operating Services.
(d) Maintains a record of all communications, orders, programs, etc., necessitating procurement within the District; enters all allocations made by Manufacturing Divisions and all projects inaugurated by Facilities Divisions in connection therewith; and determines status periodically to insure against delay due to possible loss of correspondence or misunderstanding as to responsibility for action.

4. *Relations Section*—
(a) Considers all labor problems and recommends proper action in conformity with orders promulgated from the offices of the Secretary of War and the Chief of Ordnance; and handles all District labor relations with outside agencies.
(b) Prepares all information for release to the press.

B. Engineering Service

The CHIEF OF ENGINEERING is charged with the supervision of all engineering activities within the District, particularly those affecting the prompt production and ballistic testing of ordnance material.

THE TECHNICAL SECTION—comprises the personal Offices of the Chief of Engineering and the Assistant Chief of Engineering and is charged with duties as follows:

(a) Consolidates technical reports from the Engineering Divisions for the information of the Chief of Engineering and higher authority.
(b) Correlates all joint activities of the Engineering Divisions.

1. ORDNANCE DIVISION

The Ordnance Division comprises seven Sections with duties as follows:

(a) *Proving Ground Section*—
Operates the District Proving Ground.
Conducts ballistic tests of assembled units for final acceptance.
(b) *Testing Laboratory Section*—
Operates Testing Laboratory for joint use of other units of the District organization.
(c) *Research Section*—
Mobilizes all research facilities within the District for the solution of technical problems incident to ordnance production.
(d) *Drafting Section*—
Prepares suggested revisions of ordnance drawings and texts of revision for transmittal to the Ordnance Office in Washington.
(e) *Filing Section*—
Maintains the master files of ordnance drawings, specifications, engineering data, production sketches, etc.
(f) *Printing Section*—
Provides necessary duplicates from master files of technical data by means of brown-prints, blueprints, photostats, photographs, or by mimeograph, multigraph or printing.
(g) *Distributing Section*—
Maintains mailing lists for distribution of drawings, handbooks, manuals and technical memoranda.
Supervises safekeeping of all confidential technical information issued to other units of the District.

2. CIVIL ENGINEERING DIVISION
3. MECHANICAL DIVISION
4. ELECTRICAL DIVISION
5. METALLURGICAL DIVISION
6. CHEMICAL DIVISION
7. AUTOMOTIVE DIVISION

Each of the above Engineering Divisions is charged with duties as follows:

(a) Provides consulting engineering advice in regard to all matters within the province of each specialty.
(b) Maintains liaison with parallel national engineering societies with a view to making promptly available their accumulated knowledge for the benefit of the government.
(c) Recruits engineering personnel for other Districts and establishments of the Ordnance Department.

C. Administration Service

The CHIEF OF ADMINISTRATION is charged with supervision of all administrative activities within the District, with particular attention to relieving all other Services of the details of administration insofar as possible; and in addition, is charged with all duties and responsibilities of the District not assigned to the Executive Division, or to the Chiefs of Engineering, Manufacture or Facilities.

THE CONTROL SECTION—comprises the personal offices of the Chief of Administration and the Assistant Chief of Administration, and is charged with duties as follows:

(a) Correlates all joint activities of Administrative Divisions.
(b) Exercises for, and in the name of, the Assistant District Chief, a limited control over the administrative methods of all Services and Divisions.
(c) Maintains the master organization chart of the District and all charts supplementary thereto.

1. PERSONNEL DIVISION

The Personnel Division comprises eight Sections with duties as follows:

(a) *Commissioned Section*—
Recruits, assigns and maintains Military Histories of all officers in the District.
(b) *Civilian Section*—
Procures, appoints and assigns all Civil Service employees for the District.
Arranges for and records all changes in the Civil Service status of employees in the District, including promotions, demotions, transfers, resignations, suspensions and discharges.
Handles all matters which must be taken up with the Appointment Division of the War Department and the United States Civil Service Commission, such as preparation of specifications for examinations and arrangements for examinations; and for employment in accordance with the rules of the Civil Service Commission or Executive Orders of President.

Administers the Civil Service Regulations in the District.
Assists the Efficiency Board in developing and preparing efficiency records for Civil Service employees in the District.

(c) *Training Section*—
Organizes and conducts necessary ordnance training courses within the District.
Cooperates with other training agencies in the District.

(d) *Classification Section*—
Handles all matters dealing with industrial furloughs and deferred classification (under Selective Service Act) of civilian employees in the District.

(e) *Enlisted Section*—
Recruits, inducts, assigns, examines and promotes all enlisted men in the District.
Maintains all necessary records, including qualification cards and vocational census of all enlisted men in the District.

(f) *Orders Section*—
Issues all orders changing "control" of personnel on approval of Chief of next higher unit.
Issues all Special Orders changing station of personnel on request of Chief of unit charged with "control."
Issues all Special Orders involving call to active service, travel, leave of absence, etc.
Issues all General Orders affecting organization, administration, etc., of the District as a whole.

(g) *Recruiting Section*—
Recruits necessary civilian employees in accordance with the needs of factories in the District.

(h) *Re-employment Section*—
Maintains complete plans for demobilization of all personnel employed on ordnance activities within the District.

2. MANAGEMENT DIVISION

The Management Division comprises eight Sections with duties as follows:

(a) *Methods Section*—
Studies the work and organization of the various Services and Divisions of the District with a view to bringing about such changes as may be necessary to properly coordinate their work, secure uniformity of methods, eliminate duplication of effort and insure adequacy of system.
Supervises the installation of new administrative methods, makes inspection of the operation of methods established.

(b) *Safety Section*—
Supervises the methods in use throughout the District for securing the safety of employees and safeguarding government property from accident or catastrophe.
Reports laxities in safety measures to Division of Manufacturing Service concerned.

(c) *Fire Prevention Section*—
Provides for proper fire protection and arranges for fire drills.

(d) *Identification Section*—
Issues proper identification passes for District Headquarters, Ordnance Reserve Plants, Proving Grounds and similar establishments, keeping proper records of same and controlling the use thereof.

(e) *Guard Section*—
Recruits, trains, assigns and controls civilian guards for Headquarters and plants in the District.

(f) *Welfare Section*—
Supervises all matters connected with welfare work for the civilian employees of the Ordnance Department.

(g) *Sanitation Section*—
Maintains constant supervision over water supply, sewage disposal, first aid stations, quarantine regulations and all other matters affecting the health and productivity of munition workers in the District.

(h) *Morale Section*—
Prepares posters and proclamations for stimulating production in Ordnance Reserve Plants of the District.
Assists in the preparation and distribution of motion pictures and authorized addresses to munition workers.

3. CORRESPONDENCE DIVISION

The Correspondence Division comprises six Sections with duties as follows:

(a) *Mail Section*—
Operates and controls the District Post Office which receives and distributes all incoming mail (excepting confidential communications).
Dispatches all outgoing mail for the various Services and Divisions.
Routes and follows up all communications.
Classifies, records and files all correspondence.

(b) *Stenographic Section*—
Furnishes and controls typists and stenographers for all subdivisions of District Headquarters.

(c) *Duplicating Section*—
Handles all printing and duplicating for the District except that pertaining to official drawings and texts of revisions.

(d) *Communication Section*—
Operates all means of communication, such as telephone, telegraph, radio, messenger, etc., and maintains proper records of same.

(e) *Historical Section*—
Obtains from the Services and Divisions and is responsible for the compilation of all historical data pertaining to the District.

(f) *Information Section*—
Reviews books published, collects and digests clippings from newspapers and magazines.
Secures and brings to the attention of all units of the District concerned, all other information likely to be of interest.
Supervises the distribution of all publications within the District.
Maintains the District Reference Library and serves as general source of information for all matters of interest to the various Services and Divisions.
Receives and directs visitors.

4. Contract Division

The Contract Division comprises six Sections with duties as follows:

(a) *Investigation Section*—
Makes legal investigations and reports as required.
Assists contracting officers in investigation of manufacturing firms previous to award of contracts.

(b) *Claims Section*—
Represents the Government in hearings before the Claims Board. .
Prepares minor claims for settlement by higher authority.

(c) *Archives Section*—
Maintains master file of all contracts in force in District.
Furnishes necessary copies of contracts to all proper parties.

(d) *Negotiation Section*—
Advises contracting officers regarding competency of contracting parties and other legal questions at issue.
Advises contracting officers regarding law of contracts, opinions and decisions of the courts and of the Attorney General, and decisions of the Comptroller General of the United States.
Draws up all contracts except those for personal service.
Prepares for submission to the Judge Advocate General and the Attorney General through the Chief of Ordnance, all requests for opinions and decisions on questions arising in connection with District activities.

(e) *Commandeering Section*—
Conducts on behalf of the government, all matters arising out of requests by the various Divisions for compulsory orders, requisitions or condemnations of private property, including the preparation and presentation of the necessary data for action by proper authority.
Arranges for the payment of awards in cases involving commandeering and the maintenance of all records pertaining thereto.

(f) *Patents Section*—
Advises contracting and production officers in all matters involving patents on ordnance material.

5. Finance Division

The Finance Division comprises four Sections with duties as follows:

(a) *Allotment Section*—
Makes consolidated requisition upon the Chief of Ordnance for all funds required for proper functioning of the District.
Apportions to proper Division or Service, all funds credited to the District.
Handles all accounting in regard to annual and special allotments.

(b) *Credit Section*—
Advises contracting officers as to credit standing of manufacturing firms under consideration for placing of contracts.

(c) *Disbursing Section*—
Makes all payments to contractors and suppliers in District.

(d) *Payroll Section*—
Handles all accounting connected with civilian payrolls of the District.
Pays all Civil Service employees in the District.

6. Accounting Division

The Accounting Division comprises four Sections with duties as follows:

(a) *Cost-Accounting Section*—
Handles all cost-accounting work connected with Cost-Plus Contracts and all other contracts requiring the determination of cost as prerequisite to payment.

(b) *Cost-Analysis Section*—
Determines and maintains records of the unit cost of all Ordnance property purchased or manufactured in the District.

(c) *Advisory Section*—
Makes special investigations, upon request, to determine proper cost of articles to be purchased at fixed prices.
Assists contracting officers in negotiation of Cost-Plus Contracts.
Renders other accounting services as may be required.

(d) *Audit Section*—
Examines and approves for signature, all financial accounts in the District.

7. Traffic Division

The Traffice Division comprises six Sections with duties as follows:

(a) *Shipping Order Section*—
Prepares shipping orders for all completed articles or components under instruction of higher authority.

(b) *Railroad Section*—
Studies operation of all railroads in District with a view to utilizing all available facilities to maximum extent.
Operates emergency railroad facilities where necessary.

(c) *Motor Section*—
Studies operation of motor transportation within the District with a view to utilizing all available facilities to maximum extent.
Operates emergency motor-transport express and freight service where necessary.

(d) *Priorities Section*—
Obtains necessary priorities for movement of raw material, equipment, supplies and completed articles or components.

(e) *Marine Section*—
Studies operation of lighters, barges and car-ferries in District with a view to utilizing all available facilities to maximum extent.
Operates emergency water-transportation facilities where necessary.

(f) *Passenger Section*—
Studies operation of all facilities available for transportation of munition workers in the District with a view to utilizing same to maximum extent.
Operates all government-owned passenger-carrying vehicles in the District.
Operates central garage and taxi service.
Issues all government transportation requests.

8. PROPERTY DIVISION

The Property Division comprises seven Sections with duties as follows:

(a) *Supply Section*—
Supervises supply to contractors of components or semi-finished material to be furnished by the government.

(b) *Storage Section*—
Operates government warehouses and other facilities for storage of all property awaiting shipment.

(c) *Sales Section*—
Operates depots for sale of government equipment and supplies to authorized purchasers.
Supervises sale of condemned government property.

(d) *Returns Section*—
Prepares the Consolidated Property Return for the District.
Supervises accounting for all government property in the District.

(e) *Issue Section*—
Issues direct to officers, enlisted men or military units within the District all authorized articles in accordance with regulations.

(f) *Salvage Section*—
Supervises disposal of waste, utilization of by-products and salvage of rejected material within the District.

(g) *Purchasing Section*—
Purchases all office equipment and supplies incidental to operation of government offices within the District.

D. Manufacturing Service

The CHIEF OF MANUFACTURE is charged with the supervision of all manufacturing activities within the District, particularly those of a non-commercial nature.

The ALLOCATION SECTION comprises the personal offices of the Chief of Manufacture and the Assistant Chief of Manufacture and is charged with duties as follows:

(a) Allocates to particular Divisions—for survey, placing of "tentative orders" and liaison in general—such manufacturing plants within the District as have been assigned by the War Department for the manufacture of ordnance in the event of an emergency.

(b) Reviews surveys of plants made by Divisions to determine most effective use of facilities of the District.

(c) Analyzes all schedules of requirements received from higher authority—assigning items to proper Divisions as a basis for procurement by purchase or manufacture.

(d) Consolidates requirements for raw materials and components common to more than one Division and assigns to a particular Division for procurement.

(e) Correlates all joint activities of the Manufacturing Divisions.

The MANUFACTURING DIVISIONS, each in respect to the major classifications of ordnance material indicated by their respective designations, are charged with full and final responsibility for all activities which directly affect the completion of assigned articles in required quantities, of desired quality and on specified dates.

Chiefs of Divisions are charged—for the material assigned to their Divisions—with direct responsibility for

(a) Initiation of projects to meet scheduled requirements;

(b) Securing concerted action by other Divisions where necessary;

(c) Determining, recording and reporting progress, for information of higher authority, on all approved projects.

To facilitate production and concentrate responsibility for completion of the more important components and assembled units comprising the major classifications referred to above, the Manufacturing Divisions are divided into Sections as follows:

1. AMMUNITION DIVISION
   (a) *Explosives Section*
   (b) *Forging Section*
   (c) *Machining Section*
   (d) *Loading Section*
   (e) *Accessories Section*
   (f) *Pyrotechnics Section*

2. ARTILLERY DIVISION
   (a) *Cannon Section*
   (b) *Mobile Carriage Section*
   (c) *Heavy Carriage Section*
   (d) *Recuperator Section*
   (e) *Fire Control Section*
   (f) *Accessories Section*

3. SMALL-ARMS DIVISION
   (a) *Rifle and Pistol Section*
   (b) *Machine Gun Section*
   (c) *Ammunition Section*
   (d) *Equipment Section*

4. AUTOMOTIVE DIVISION
   (a) *Tank Section*
   (b) *Trailer Section*
   (c) *Vehicle Section*
   (d) *Tractor Section*
   (e) *Accessories Section*

5. AIRCRAFT ARMAMENT DIVISION
   (a) *Bomb Section*
   (b) *Machine Gun Section*
   (c) *Cannon Section*
   (d) *Accessories Section*

6. GAGE DIVISION
   (a) *Ordnance Section*
   (b) *Checking Section*
   (c) *Commercial Section*

7. GENERAL SUPPLY DIVISION
   (a) *Metals Section*
   (b) *Hardware Section*
   (c) *Miscellaneous Section*
   (d) *Wood Section*
   (e) *Leather Section*
   (f) *Textile Section*

Manufacturing Sections are charged insofar as may be applicable, with the following duties in regard to the material assigned each Section for procurement:

1. Procurement Branch
   (a) Surveys existing manufacturing plants, under instruction of Chief of Division, to determine suit-

ability for manufacture of articles of ordnance assigned to Section for procurement.

(b) Outlines general specifications as to location, output, etc., for such additional facilities as may be necessary to meet requirements for articles of ordnance assigned to Section for procurement.

(c) Places "Tentative Orders" for emergency production of articles of ordnance assigned Section for procurement.

(d) Negotiates and, with the approval of Chief of Division, executes contracts for manufacture of articles of ordnance assigned Section for procurement.

(e) Assigns to Ordnance Reserve Plants, supervises and controls all necessary commissioned, enlisted and Civil Service personnel stationed at factories manufacturing ordnance under contracts placed by the Section.

2. Production Branch

(a) Takes all necessary steps to secure production according to established schedule of articles of ordnance assigned Section for procurement.

(b) Collects and codifies all information relative to manufacture of articles of ordnance assigned Section for procurement.

(c) Studies methods, machinery and tools, so as to indicate the best methods of manufacture, the production that should be attained with various types of equipment, tools, etc., and compiles, or causes to be compiled, data of this character in such form as to facilitate the making of estimates of production and enable the comparison of actual production with that which the estimates show should be attained.

(d) Assists new manufacturers to get started, supplying them with such data concerning equipment, methods of manufacture, sources of raw material, etc., as may be necessary.

Assists manufacturers already established by disseminating the results obtained in various plants manufacturing the same articles, systematically making available to all manufacturers the practice of the best with a view to enabling all to reach the highest standards with respect to quantity and quality of output; and maintains a corps of qualified experts who may be sent to plants that are having difficulties in meeting their schedules to assist them in overcoming their troubles.

3. Inspection Branch

(a) Inspects and accepts for the Government, all articles of ordnance and all ordnance stores and supplies procured by purchase or manufacture, following the results of all operations and processes in such detail as will secure complete information as to the quality of the product during all stages of manufacture.

(b) Receives reports of proving ground tests made for the acceptance of material and forwards same to proper authority.

Chiefs of Sections are charged—for the specific articles of ordnance assigned to their Sections for procurement—with direct responsibility for

(a) Producing the completed, inspected articles on the dates specified.

(b) Training of all personnel involved in any of the operations incidental to achieving the desired results.

E. Facilities Service

The Chief of Facilities is charged with the supervision of all activities involving construction of plant, installation of equipment and operation of utilities within the District.

The Project Section comprises the personal offices of the Chief of Facilities and the Assistant Chief of Facilities, and is charged with duties as follows:

(a) Maintains complete records of all approved projects requiring alterations of existing plants or construction of new plants; and determines status periodically to insure against delay due to loss of correspondence or misunderstanding as to responsibility for action.

(b) Prepares progress reports for information of Chief of Facilities and higher authority.

(c) Correlates the joint activities of the Facilities Division.

(d) Maintains liaison with other Services of District Headquarters.

1. Design Division

The Design Division comprises seven Sections with duties as follows:

(a) *Drafting Section*—
Operates central drafting room for Facilities Service.

(b) *Layout Section*—
Prepares general layouts for all new projects.
Designs manufacturing buildings.
Compiles data covering approved layout of machinery for typical manufacturing units.
Prepares layout of machinery for all new factory construction.

(c) *Transportation Section*—
Designs docks, railroad yards and sidings, highways, etc., incidental to new construction for government use.
Determines specifications for barges, tow-boats, industrial locomotives and cars, etc., required for operation of new facilities.

(d) *Machinery Section*—
Designs, or determines specifications for, all production machinery required for operation of new facilities.

(e) *Housing Section*—
Designs all cantonments, industrial barracks, cafeterias, recreation buildings at isolated plant sites.
Designs standardized types of houses, apartment buildings, etc., to provide additional housing in industrial centers where needed to take care of additional war load.

(f) *Power Section*—
Designs power houses, transformer stations, transmission lines required by new construction.

(g) *Auxiliaries Section*—
Designs or determines specifications for cranes, craneways, air-compressors, pumps, water tanks and piping, etc., required for operation of new facilities.

2. Estimates Division

The Estimates Division comprises five Sections with duties as follows:

(a) *Building Section*—
Checks and approves all estimates for construction of buildings.
Checks cost reports on building construction work and certifies vouchers for payment.

(b) *Auxiliaries Section*—
Checks and approves all estimates for purchase of auxiliaries.
Checks vouchers for payment for auxiliaries.

(c) *Survey Section*—
Surveys all sites available for extension of existing facilities or construction of new facilities.
Compiles complete estimates on project on basis of details prepared by other sections.
Maintains record of costs of projects under construction.

(d) *Machinery Section*—
Checks and approves all estimates for purchase of machinery.
Checks vouchers for payment for machinery.

(e) *Apparatus Section*—
Checks and approves all estimates for purchase or construction of all apparatus incidental to chemical processes.
Checks vouchers for payment for apparatus.

3. PROCUREMENT DIVISION

The Procurement Division comprises seven Sections with duties as follows:

(a) *Materials Section*—
Purchases all building material required for new construction.

(b) *Apparatus Section*—
Purchases all chemical apparatus required for new construction.

(c) *Machinery Section*—
Purchases all heavy machinery needed for new construction.

(d) *Machine Tools Section*—
Purchases all machine tools required for new construction.

(e) *Power Section*—
Arranges for proper supply of steam, water or electric power needed by new facilities.
Makes reports on costs of obtaining such supplies.

(f) *Small Tools Section*—
Purchases all small tools needed for new construction.

(g) *Site Section*—
Purchases or leases necessary sites for extension of existing facilities or construction of new facilities.

4. CONSTRUCTION DIVISION

The Construction Division comprises six Sections with duties as follows:

(a) *Factory Section*—
Supervises construction of all industrial buildings.
Makes regular reports on progress of construction.

(b) *Power House Section*—
Supervises construction of all power-houses and related structures.
Makes regular progress reports.

(c) *Auxiliaries Section*—
Supervises construction of all auxiliary buildings.
Makes regular progress reports.

(d) *Housing Section*—
Supervises construction of all housing.
Makes regular progress reports.

(e) *Transportation Section*—
Supervises construction of all roads, docks, railroad yards and sidings.
Makes regular progress reports.

(f) *Warehouse Section*—
Supervises construction of all warehouses, etc.
Makes regular progress reports.

5. INSTALLATION DIVISION

The Installation Division comprises five Sections with duties as follows:

(a) *Machine Tools Section*—
Supervises installation of all machine tools required for new facilities.
Makes regular progress reports.

(b) *Apparatus Section*—
Supervises installation of all chemical apparatus.
Makes regular progress reports.

(c) *Auxiliaries Section*—
Supervises installation of all auxiliary machinery.
Makes regular progress reports.

(d) *Power Section*—
Supervises installation of all power equipment.
Makes regular progress reports.

(e) *Machinery Section*—
Supervises installation of all heavy machinery.
Makes regular progress reports.

6. OPERATION DIVISION

The Operation Division comprises two Sections with duties as follows:

(a) *Utilities Section*—
Operates all central power houses, transmission lines, transformer stations, etc., required for the joint use of plants engaged on government work.

(b) *Communities Section*—
Supervises the administration of all communities which are on a semi-military status, such as government plants, housing projects, etc.

IV. THE ADVISORY BOARD

1. THE ADVISORY BOARD, through the training and experience of its members, brings to bear upon problems of general policy comprehensive knowledge of industrial organization, basic, raw and semi-finished materials, manufacturing, merchandising, law, finance, power, publishing, communication, construction and transportation, as well as government requirements and procedure. Its principal functions are to consider questions of general policy affecting the interests of the District as a whole, to recommend such courses of action as will most effectively utilize the District's total resources toward meeting the government's total requirements allocated to the District, and to advise the District Chief in such other instances as may from time to time appear necessary or desirable.

2. The present membership of the Advisory Board is as follows:

E. H. Gary, Chairman, United States Steel Corporation, Chairman;

P. E. Crowley, President, New York Central Lines;

J. M. Davis, President, Delaware, Lackawanna & Western R. R.;

John I. Downey, President, John I. Downey & Co., Inc.;
M. Friedsam, President, B. Altman & Co.;
S. Parker Gilbert, Jr., Agent-General of Reparations in Germany;
James G. Harbord, President, Radio Corporation of America;
Herbert P. Howell, Vice-President, Peierls, Buhler & Co., Inc.;
James H. McGraw, President, The McGraw-Hill Co., Inc.;
Samuel McRoberts, Chairman, Chatham-Phenix National Bank & Trust Co.;
Dwight W. Morrow, of Messrs. J. P. Morgan & Co.;
Seward Prosser, Chairman, Bankers Trust Company;
Charles M. Schwab, Chairman, Bethlehem Steel Corporation;
Guy E. Tripp, Chairman, Westinghouse Electric & Manufacturing Co.;
B. L. Winchell, Chairman, Remington-Noiseless Typewriter Co.;
William H. Woodin, President, American Car & Foundry Co.;
Owen D. Young, Chairman, General Electric Company.

V. THE CLAIMS BOARD.

1. The Claims Board is an agency for prompt investigation of such differences of opinion as may naturally arise between government contracting, inspecting, accounting, and disbursing officers, and representatives of contractors. Its function is to conduct hearings on appeals from rulings, to determine facts and to recommend an equitable basis for final settlement, having due regard for conditions of stress which obtain at the time and with a view to obviating needless and costly litigation at a later date.

2. The membership of the Claims Board has not yet been selected.

VI. THE ORDNANCE RESERVE PLANTS.

EMERGENCY PRODUCTION PLANS

1. The Ordnance Reserve Plants constitute the real power of the District as an element in National Defense. District Headquarters know the Army's needs for ordnance; the Advisory Board interprets these requirements to Industry and Industry's capacity, in turn, to the government; the Claims Board seeks to secure just treatment for Industry in its efforts to meet the government's requirements; but Industry—and Industry only—through the Ordnance Reserve Plants can produce and deliver ordnance. Commercial factories allocated by The Assistant Secretary of War for production of ordnance in emergency are designated as Ordnance Reserve Plants on evincing a willingness to cooperate with District Headquarters in effecting a reasonable degree of Industrial Preparedness. They have a status as corporations analogous to that occupied by Ordnance Reserve Officers as individuals.

2. In peace time, the principal function of the Ordnance Reserve Plants is the preparation of their Emergency Production Plans for the manufacture of such articles of ordnance as have been allocated to them by District Headquarters. As practically every item of ordnance is somewhat different from every other item, each Emergency Production Plan will necessarily be different from every other, but in general, it should include the following items:

(a) Copy of the "Tentative Order" including the production schedule.
(b) Complete set of drawings and specifications.
(c) An outline statement of the steps to be taken to put a contract in effect in time of emergency.
(d) Operation or route sheets giving the different operations necessary to the production of the article covered by the "Tentative Order," in the proper order and sequence.
(e) Statement of requirements on outside sources of supply for the following items necessary to the execution of the work:
  (1) Raw Material,
  (2) Manufactured Components,
  (3) Semi-finished Components,
  (4) Production Machinery,
  (5) Machine Tools,
  (6) Jigs and Fixtures,
  (7) Small Tools,
  (8) Gages,
  (9) Instruments,
  (10) Miscellaneous Equipment,
  (11) Additional Power Requirement.

  These statements should give the total quantities required annually, should indicate the proposed source of supply and should give the necessary schedule of deliveries f. o. b. the works, making due allowance for the time that will be consumed in transportation and manufacturing operations.
(f) A tentative proposal and contract ready for execution.

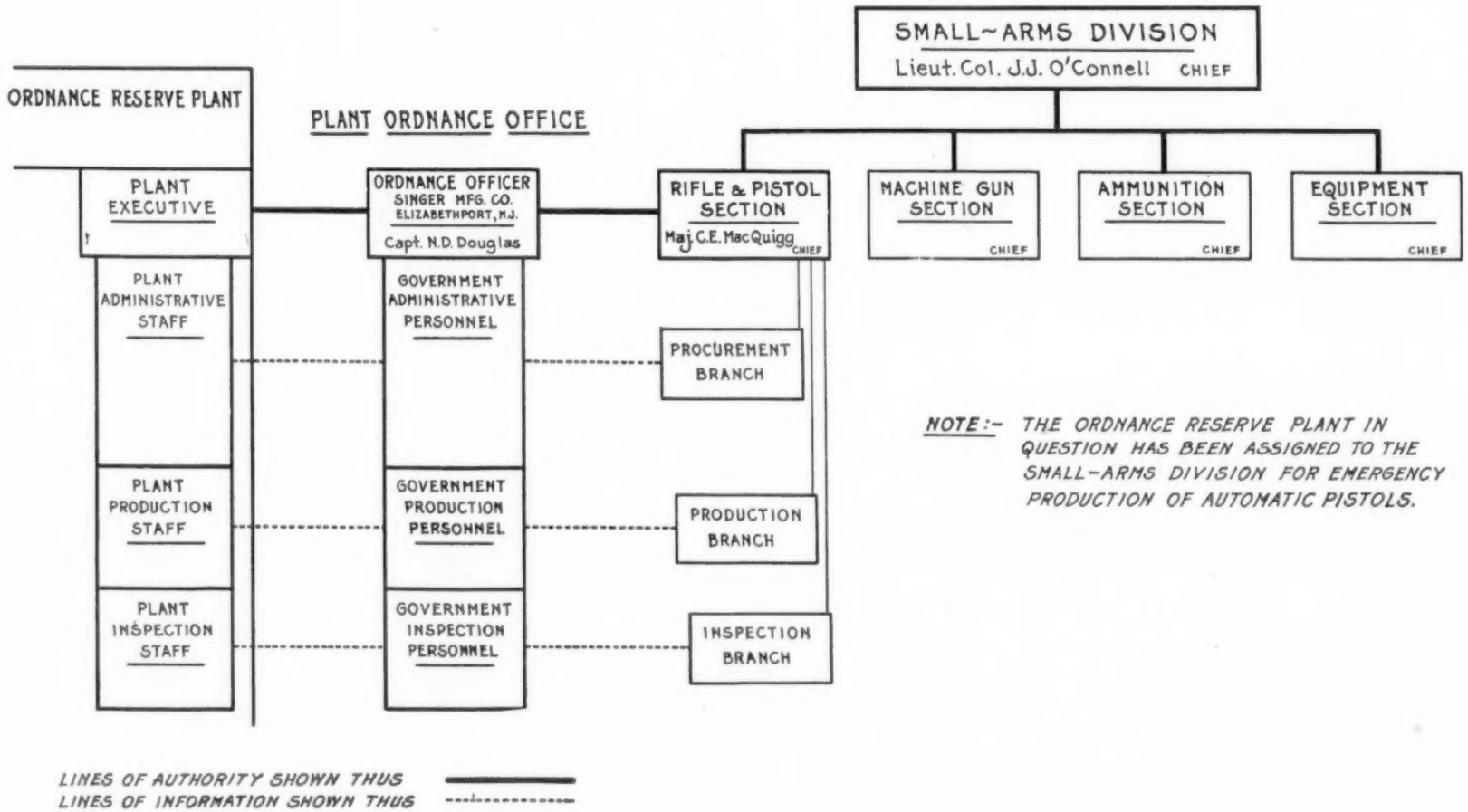
3. These studies when completed should be bound, or filed together and kept so they may be reviewed annually, or whenever necessary. The determination of the requirements mentioned in paragraph 2-e above will enable definite priorities to be established in advance on the deliveries of these supplies, and also insure that the contemplated sources of supply may be relied upon when, as, and if the contemplated emergency becomes a fact.

4. Good judgment dictates that nothing should actually be done in advance that can be done without loss of time after an emergency has arrived and definite decision to proceed to manufacture has been annouced. The determination of requirements, the setting of priorities and the insuring of sources of supply can be accomplished *in advance* infinitely better than after an emergency has become a fact, and the time thus saved is of very great importance.

5. The Plan should be as simple and brief as possible, consistent with its effectiveness. It should be kept in the factory only. Copies of all requirements should be filed with District Headquarters in order to arrange for priorities and assurance of supply. Otherwise, only such copies as are deemed necessary in the factory should be prepared.

6. District Headquarters should be freely consulted regarding any question that may arise. Manufacturing information in the possession of the Ordnance Department will be supplied, as will samples for study, special tools and, in some cases, sample lots of raw material when available and where such action is appropriate. The War Department thoroughly appreciates the good-will and cooperation shown by the manufactures in the expenditure

A TYPICAL CHART SHOWING CHANNELS OF COMMUNICATION BETWEEN AN ORDNANCE RESERVE PLANT AND DISTRICT HEADQUARTERS



of effort to prepare Emergency Production Plans, and the Officers of the Army stand ready to reciprocate by giving every assistance possible.

Eventually, it is hoped that Congres, by legislative enactment, will give to the Ordnance Reserve Plants, a dignified and honorable status in recognition of their valuable contribution toward National Defense in the shape of completed Emergency Production Plans.

7. A further step toward complete Industrial Preparedness would be the placing of "Educational Orders" for manufacture of articles of ordnance to fill current requirements. Just when this logical step will be authorized by Congress, it is at present impossible to predict. In the meantime, however, much can be accomplished in attaining a state of *readiness* to produce, when and if necessary appropriations shall be made.

CONTACT BETWEEN ORDNANCE RESERVE PLANTS AND DISTRICT HEADQUARTERS

1. During the World War, contractors for government supplies were frequently worried and sometimes completely exasperated by conflicting instructions received from different officials, each seemingly having the full weight of governmental authority behind him. In order to speed up manufacture, production officers authorized, and, in certain instances, directed procedure which inspecting officers later disapproved by refusing to accept articles not manufactured in strict accordance with government specifications. In order to obviate a recurrence of this obviously unsatisfactory condition of affairs, a resident Ordnance Officer will be appointed for each Ordnance Reserve Plant and all contact between the government and the contractor, whether it relates to procurement, production, inspection, priority, additional facilities or administration activities such as accounting, payment, shipment, etc., will be made through the Ordnance Officer.

2. Whenever an initial allocation is made to an Ordnance Reserve Plant, an Ordnance Officer will be assigned by the Section Chief of the Manufacturing Service charged with procurement of the article to be manufactured. No additional orders, either for other articles of ordnance or for any other governmental work will be placed with this Ordnance Reserve Plant, except with the approval of the Section Chief and through the resident Ordnance Officer at the plant, whose instructions as to priority of different orders will be final and binding upon all concerned.

3. In the discharge of his duties, the Ordnance Officer will be assisted by necessary production and inspection personnel assigned by the Section Chief or Chiefs concerned, and by necessary administrative and facilities personnel assigned by the Chiefs of the Administration and Facilities Services respectively. The latter officers are responsible for the technical instruction of the personnel so assigned and may call upon them direct for information necessary to the functioning of their respective Services, but all government personnel at the plant reports to the Ordnance Officer resident thereat for assignment to specific duties and discipline. The Ordnance Officer is the sole channel through whom instructions affecting the completion of contracts are conveyed.

VII. ORDNANCE RESERVE OFFICERS.

ASSIGNMENTS TO DUTIES

1. The following officers (Ordnance Reserve except where otherwise stated) have been assigned to duties as indicated below:

Assistant District Chief, Col. *C. C. Goodrich.*
Executive Division—Chief, Capt. *H. W. Churchill,* U. S. Army,
Asst. Chief, 1st Lieut. *J. L. Holman,* U. S. Army.
Engineering Service, Chief, Lieut. Col. *F. P. Lindh,*
Asst. Chief, Maj. *J. E. Fullam.*
Ordnance Division—Chief, Maj. *H. C. Strohm,*
Asst. Chief Maj. *J. W. Mailler.*
Administration Service, Chief, Lieut. Col. *R. D. Coombs,*
Asst. Chief, Maj. *E. G. Curtis* (acting).
Personnel Division—Chief, Capt. *C. T. Naumburg,*
Asst. Chief, Capt. *W. H. Milholland.*
Management Division—Chief, Lieut. Col. *F. A. Rogers,*
Asst. Chief, Capt. *L. C. Stowell.*
Correspondence Division—Chief, Capt. *C. N. Peacock,*
Asst. Chief, Capt. *J. L. Delius.*
Contract Division—Chief, Maj. *E. G. Curtis,*
Asst. Chief, Maj. *G. N. Huntting.*
Finance Division—Chief, Maj. *Frank Altschul,*
Asst. Chief, Maj. *G. A. Voss.*
Accounting Division—Chief, Maj. *A. H. Clarke,*
Asst. Chief, Capt. *J. T. Collins.*
Traffic Division—Chief, Capt. *L. T. Crutcher,*
Asst. Chief, Capt. *G. O. Walton.*
Property Division—Chief, Capt. *F. R. Slater,*
Asst. Chief, Capt. *E. G. Davis.*
Manufacturing Service, Chief, Lieut. Col. *F. W. Roller,*
Asst. Chief, Maj. *C. E. Davies.*
Ammunition Division—Chief, Maj. *Crosby Field,*
Asst. Chief Maj. *J. D. Murray.*
Artillery Division—Chief, Lieut. Col. *R. R. Harrison,*
Asst. Chief, 1st Lieut. *C. W. Bryden.*
Small Arms Division—Chief, Lieut. Col. *J. J. O'Connell,*
Asst. Chief, Maj. *C. E. MacQuigg.*
Automotive Division—Chief, Maj. *H. G. Hawes,*
Asst. Chief, Capt. *V. J. Vashon.*
Aircraft Armament Division—Chief, Maj. *R. Walsh,* Air Service, U. S. Army,
Asst. Chief, Maj. *C. E. Sholes.*
Gage Division—Chief, Maj. *J. B. Elmendorf,*
Asst. Chief, 1st Lieut. *C. A. Bergman.*
General Supply Division—Chief, Maj. *C. E. Davies* (acting),
Asst. Chief, 1st Lieut. *Jack Strauss.*
Facilities Service, Chief, Col. *J. C. Heckman,*
Asst. Chief, Maj. *C. H. Higgins.*
Design Division—Chief, Maj. *R. W. Gardner,*
Asst. Chief, Capt. *A. W. Coombs.*
Estimates Division—Chief, Maj. *W. S. Schneider,*
Asst. Chief, Capt. *J. J. Klaber.*
Procurement Division—Chief, Maj. *John Curtin,*
Asst. Chief, 1st Lieut. *Louis Small.*
Construction Division—Chief, Maj. *W. S. Schneider* (acting),
Asst. Chief, Capt. *J. J. Klaber* (acting).
Installation Division—Chief, Maj. *J. C. Hardigg,*
Asst. Chief, Capt. *J. J. Burling.*
Operation Division—Chief, Maj. *A. G. Blake,*
Asst. Chief, 1st Lieut. *W. V. Walsh.*

2. All of the above-named officers have participated in the discussions incident to the drafting of these notes.

The assistance derived from their constructive suggestions is hereby acknowledged.

TABLE OF ORGANIZATION, N. Y. O. D.

1. During the past year, a Board of Officers, consisting of Col. *C. C. Goodrich,* Assistant District Chief, President; Col. *J. C. Heckman,* Chief of Facilities; Lieut. Col. *F. W. Roller,* Chief of Manufacture; Lieut. Col. *R. D. Coombs,* Chief of Administration; Lieut. Col. *F. P. Lindh,* Chief of Engineering; Major *C. E. Davies,* Asst. Chief of Manufacture; and 1st Lieut. *J. L. Holman,* Ordnance Department, United States Army, Recorder, has studied the commissioned personnel requirements of the District with a view to determining by grades and numbers, the proper assignment of Ordnance Reserve Officers to the various Services, Divisions and Sections. In arriving at its conclusions, the Board proceeded under the following basic assumptions:

(a) The peace-time personnel of the District should conform to the approved Six Army Program of the War Department and should approximate (in grades and numbers), the minimum active-duty status of the District as of "M + 90 Day"—i. e., 90 days after the declaration of the existence of a major emergency requiring inauguration of a full production schedule.

(b) With the exception of the membership of the Advisory Board and the Claims Board, all executive positions in the District organization should be filled by commissioning and assigning Ordnance Reserve Officers.

(c) In order to reduce to a minimum the District's requirements for commissioned personnel, an officer should, wherever practicable, be assigned to supervision of more than one Division or Section having somewhat similar functions.

(d) High-grade Civil Service personnel should be employed and assigned to minor executive positions wherever practicable.

2. Based upon the Board's recommendations, the following Table of Organization has been forwarded to higher authority with recommendation for approval.

TABLE OF ORGANIZATION, NEW YORK ORDNANCE DISTRICT, APRIL 6, 1926.

	Executive Division						Engineering Service									Administration Service										Manufacturing Service											Facilities Service									Totals		
	District Chief's Office	Intelligence Section	Liaison Section	Co-ordination Section	Relations Section	Total—Executive Division	Technical Section	Ordnance Division	Mechanical Division	Chemical Division	Electrical Division	Civil Engineering Division	Metallurgical Division	Automotive Division	Total—Engineering Service	Control Section	Personnel Division	Management Division	Correspondence Division	Contract Division	Finance Division	Accounting Division	Traffic Division	Property Division	Total—Administration Service	Allocation Section	Ammunition Division	Artillery Division	Small Arms Division	Automotive Division	Aircraft Armament Division	Gage Division	General Supply Division	At Ordnance Reserve Plants	Total—Manufacturing Service	Project Section	Design Division	Estimates Division	Procurement Division	Construction Division	Installation Division	Operation Division	Total—Facilities Service	Total—Executive Personnel	Training Cadre	Total—Commissioned Officers
Civilian	1	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..
Colonels	1	..	..	..	..	1	1	..	..	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..	1	1	..	..	..	..	..	1	5	..	5
Lieutenant Colonels	..	..	..	..	..	..	1	1	..	..	..	..	..	..	2	1	1	..	..	1	..	..	..	..	3	1	1	1	1	1	1	1	..	3	10	1	1	1	1	1	..	..	5	20	..	20
Majors	..	1	1	1	1	4	..	3	1	1	1	1	1	1	9	..	1	1	1	3	1	1	1	1	10	1	6	4	4	3	4	2	1	21	46	..	3	3	1	2	1	1	11	80	..	80
Captains	1	1	1	1	1	5	..	7	..	..	..	..	..	..	7	1	7	3	5	8	5	5	6	7	47	1	9	4	6	2	4	3	7	49	85	1	4	2	4	3	3	3	20	164	..	164
1st Lieutenants	1	1	..	..	..	2	..	8	1	1	1	1	1	1	14	1	9	9	2	8	4	4	5	8	50	..	9	5	3	..	3	3	5	18	46	1	4	2	4	5	2	2	20	132	..	132
2nd Lieutenants	..	..	..	..	..	..	..	6	..	..	..	..	..	..	6	..	2	2	..	..	..	..	..	1	5	..	..	..	..	..	..	..	..	18	18	..	..	..	..	..	..	..	..	29	60	89
Total	4	3	2	2	2	13	2	25	2	2	2	2	2	2	39	4	20	15	8	20	10	10	12	17	116	4	25	14	14	6	12	9	13	109	206	4	12	8	10	11	6	6	57	*431	60	490

*Includes 1 civilian as District Chief.

VIII. CONCLUSION.

The manufacturing industries of America are now paying three-fourths of the total taxes of the nation. The larger part of tax receipts are being used, and will continue to be used for years to come, for paying the cost of our participation in the World War. Due to our lack of preparation, particularly in the industrial phases, costs were needlessly high. Expenditures averaged *a million dollars per hour for the entire two years* beginning April 6, 1917. For every forty days the war could have been shortened, a billion dollars could have been saved our taxpaying manufacturers. By doing all the things that can and should be done prior to the outbreak of war, Industrial Preparedness seeks to shorten the duration of a possible conflict and lessen the resulting tax burden in proportion. If eventually we are able to match our unrivalled man power with promptly available and adequate munition power, we can make America so strong that no nation or group of nations will dare attack us. In this sense Industrial Preparedness is Insurance *Against* War.

JAMES L. WALSH,
Colonel, Ordnance Reserve,
District Chief.

Official:

R. D. COOMBS,
Lieut. Col., Ordnance Reserve,
Chief of Administration.

New Methods in Exterior Ballistics

A Review

Capt. James L. Guion, Ord. Dept., U. S. A.

New Methods in Exterior Ballistics. By Prof. F. R. Moulton. Chicago: University of Chicago Press. 1926.

"THE general problem of exterior ballistics is that of determining all the properties of the motion of a projectile which leaves the muzzle of a gun with known components of velocity, and with a given rate of rotation about its axes." This problem has aroused the interest of some of the greatest mathematicians and physicists for the past four hundred years. Its treatment has been characterized by elaborate experiments combined with the most advanced theory of the times. In spite of all this work the solutions have been only approximations which satisfied the moderate requirements of earlier artillery practice. But the new demands made upon artillery during the recent war and the changes in artillery practice necessitated by barrage, counter-battery, and antiaircraft fire required a greater accuracy in the computation of range tables, a method of handling variations from range table conditions, a knowledge of the coordinates of the projectile and its components of velocity all along the trajectory, and an adequate theory for the improvement in the design of projectiles.

PROF. F. R. MOULTON

The Army Ordnance Department was fortunate in securing Professor F. R. Moulton to supervise its ballistics work, both theoretical and experimental. He was commissioned in the Ordnance Department and ordered to active duty in charge of the Ballistics Section of the Engineering Division in April, 1918, and at once surrounded himself with a corps of assistants which included some of the most brilliant of America's mathematicians and physicists. He came to this work equipped with the finest tools of a mathematician, and a keen and well developed physical intuition. To these rare qualifications may be added a high sense of duty, initiative, and unlimited energy. He discarded immediately the awkward methods then in use and gave a logical, direct, and more accurate treatment of the problem. The improvements made in projectile design and in the calculation of range tables under his direction indicate clearly the practical manner in which he handled the problem.

Since the war, certain officers of the Army and Navy have been detailed to study ballistics, mathematics, and physics under the direction of Professor Moulton at the University of Chicago. As a consequence of this and of his duties during the war, he has now published the results of his investigations. Progress in physical research is only realized by extensive experiment supported by an adequate theory. During the war he indicated the type of experiments needed and developed certain theories of great practical value. His completed theory, which leaves no questions unanswered from either the theoretical or practical point of view, he has now given us in his book. This book should interest not only the army officer and manufacturer of ammunition, but the mathematician as well. It is an excellent example of the solution of a practical problem by means of some of the most modern theories for the solution of differential equations.

The first step toward a solution of a problem in mechanics is its statement. With forces that vary continuously with the time, differential notation is necessary, and an explicit expression in mathematical terms of the ballistic problem takes the form of differential equations of motion. The author sets up these equations in the first chapter, leading by simple and easily understood transformations from equations for motion on a fixed, flat earth to the general equations for motion on a rotating earth.

The complete differential equations of motion would involve expressions for the accelerations due to the many factors upon which the motion of the projectile depends, but it is advisable and permissible in computing basic range table trajectories to consider only the principal factors which determine the flight of the projectile, namely, the initial velocity, gravity, and the resistance of the air, and to treat minor supplementary factors separately.

In the second chapter the author discusses the forces on which the computation of basic trajectories depends. Gravity is most readily determined by pendulum experiments and the accuracy attained exceeds the requirements of the ballistic problem. On the other hand, a theoretical determination of the forces due to the resistance of the air is practically impossible and their experimental determination is costly and difficult. The resistance function at present in use in our service is probably far from accurate.

The author treats the resistance function first from the

standpoint of the homogeneity of dynamical equations and deduces some general properties of the function. Next follows a theoretical derivation, based on assumptions which are approximately true in the case of a projectile moving through the air at a velocity greater than that of sound, for the case of a cylinder, a cylinder with a hemispherical head, a cylinder with an ogival head, and a cylinder with a conical head. This discussion points to a logical reason for the replacement of the two caliber ogive by a four or five caliber ogive. He next gives an explanation of the condensation waves observed in photographs of projectiles moving at velocities greater than that of sound. He concludes the chapter with a new method of determining the resistance function experimentally which avoids the logical defects and the practical difficulties of methods previously used, and which for a particular projectile gives a very precise method of calculating the resistance function. He points out the necessity of determining this function experimentally with the type of projectile used in practice, and the great need in our service of an accurate determination for modern projectiles.

The determination of the resistance function experimentally gives a set of numerical values which may be tabulated with velocity as an argument. Previous to the last war it was the custom to fit a series of formulas to these values for various ranges of velocity in order to make it possible, after neglecting the variations in the density of the air, to integrate the equations of motion by the methods then in use. But Professor Moulton introduced a direct method that did not depend upon a formula, but used only tabular relations between resistance and velocity. Moreover, it took directly into account the variations in the density of the air with altitude. The function for the normal retardation of the atmosphere is expressed in the form $\frac{G\,H}{C}$ where G is a tabulated function of velocity alone and determined experimentally, H is a function which expresses the normal variation in the density of the air with altitude, and C is a constant depending upon the weight and form of the projectile and is called the "ballistic coefficient."

The method which the author calls the numerical solution of differential equations, is based on the hypothesis that the resistance function satisfies the so-called "Lipschitz condition", a condition slightly stronger than continuity. This process admits of any desired degree of accuracy and is the simplest means now known for finding the solution of differential equations in cases where the variables cannot be separated. Chapter three is devoted to the exposition of this process.

"It is generally assumed that all differential equations have solutions and that the only problem is that of discovering them. This, however, is not the case. An essential part of the problem is to prove that when the functions considered have certain specified properties, the solutions exist and have certain resulting properties." These questions are treated in chapter five. Therein is given a complete proof of the validity of the process. To the mathematician this particular chapter should be very interesting, because in addition to a very clear presentation of the logic underlying the process of numerical integration, it contains original contributions of the author to the science of mathematics.

For the requisite accuracy of present day artillery practice, it is necessary to consider, in addition to the forces of gravity and normal air resistance, certain minor factors which produce appreciable effects. Some of these, such as the dimunition in gravity with altitude above the surface of the earth, the influence of the rotation of the earth, the allowable variations in the weights of shells, and the curvature of the earth's surface, are independent of the time. Others, such as abnormal air densities, winds, and variations in temperature, are functions of the time and must be taken into account at the time of firing. Since it is obviously impossible to use range tables having as arguments all factors upon which the motion of the projectile depends, the effects of these minor factors must be given in supplementary tables to be applied as relatively small corrections to the results for normal conditions.

Again Professor Moulton has avoided the laborious earlier processes and has proceeded directly to the solution. A trajectory calculated by the methods of chapter three is considered a normal trajectory, and the effects produced by minor factors are treated as "differential variations" from such a trajectory. Suppose, for example, that two projectiles, similar save that they differ slightly in weight, are fired from a gun under exactly similar atmospheric conditions. They leave the gun with slightly different muzzle velocities and have slightly different ballistic properties in flight. If one of these projectiles is considered normal, then the different weight of the other projectile causes abnormal initial conditions and abnormal exterior accelerations. If the effect on the range is great enough to cause difficulty in the adjustment of fire, this difference in weight must be considered. An obvious way of taking the variation into consideration would be to have separate range table trajectories calculated for the two weights of projectiles. It is possible, however, to secure either trajectory from the other by certain valid processes which involve much less labor.

These new and greatly superior methods are developed in chapter four. First are set up the differential equations which express the variations from the normal trajectory for abnormal initial conditions and abnormal exterior forces. Next is given the method of solving these equations in which terms of the second and higher degree are neglected. This reduces the problem to a set of linear differential equations, the solution of which is much simpler than the general case. The solution is obtained with a surprisingly small amount of labor and is sufficiently accurate for present ballistic practice. The author also gives the solution of the complete equations for variations as a guide if greater accuracy should ever be desired.

Next he considers in detail each minor factor which affects the motion of the projectile, and developes an explicit expression for its effects and gives the method of applying them. Two difficulties arise in computing and applying corrections for the variable abnormal forces due to winds, abnormal air densities, and variations in temperature. First, these factors can be determined in practice for only a limited number of values. For example, the meteorological service determines a mean wind for the first hundred feet above the earth's surface, another value for the mean wind for the second hundred feet, etc. Second, these factors cannot be determined much in advance of the time of firing if they are to be of any value. Consequently, unless some simplification were made it would

be impossible to make use of these corrections in the field. These difficulties are overcome and results are obtained that are sufficiently accurate by the use of weighting factors. Professor Moulton gives a very clear and concrete discussion of the determination, and use of weighting factors.

For any particular trajectory computed by the methods outlined in this book, the following information is obtained; first, the coordinates of the projectile and its components of velocity all along the trajectory; second, the effects of abnormal initial conditions and certain abnormal exterior forces on the coordinates and components of velocity all along the trajectory; and finally, the effects of the variable abnormal forces due to winds, abnormal air densities, and variations in temperature on the coordinates and components of velocity for zones covering the whole trajectory. This information is certainly all that might be desired for any kind of firing. Further, these data are arranged in such a form that the application of the necessary corrections in the field is a relatively simple matter.

The ultimate goal, however, is the determination of complete range tables for a particular gun, powder charge, and projectile, so that any condition met with in the field can be easily and rapidly considered and an optimum accuracy in firing attained. The determination of such tables directly would necessitate a great deal of laborious computation, and, considering the number and variety of guns and types of projectiles, would result in considerable duplication. Consequently, it is economical to construct general ballistic tables from which special range tables can be obtained with a relatively small amount of work. Professor Moulton shows how such a table can be constructed so that all the necessary data can be determined for any range table from a relatively small number of computed trajectories and certain functions of their variations. He does not use the ordinary methods of interpolation, which would be costly because of the number of different arguments involved, but developes a simpler scheme depending upon the use of differential variations. The primary complicated computations could be carried out in a well organized computing office and only relatively simple applications of linear equations would be necessary in constructing a required range table.

The preceding chapters have dealt with the practical problem of computing range tables. Up to this point the fact that the axis of the projectile does not in general coincide with the tangent to the trajectory and that the projectile is spinning about this axis have not been taken into consideration. Yet, these are considerations which cannot be omitted in the general solution of the problem because only by the investigation of these effects can improvements in design be accomplished. Many experiments have been made with this alone in view, but what has been most needed is an adequate theory which will enable us to separate out the individual causes from the combined and integrated effects. Other men have secured certain isolated characteristics of this motion, but Professor Moulton has given a complete treatment of this phase of the problem.

Chapter six is devoted to the consideration of the general problem of rigid dynamics, a body moving through a resisting medium without restraint. The form of the differential equations have been known since the time of Euler, but Professor Moulton has derived them in order to make clear the geometrical and physical meaning of the variables he uses. Three special cases of this problem admit a complete solution. The author shows how, by certain simplifying assumptions, the problem of the motion of a rotating projectile can be reduced to one of these special cases, the problem of Lagrange; i. e., a rigid body with one restraint and a force acting parallel to one of the axes of reference. The general motion with respect to the tangent to the trajectory thus deduced, the original hypotheses are altered until the actual problem is presented.

The preliminary assumptions are these:

1. That the rate of spin about the axis of symmetry is a constant.

2. That in a limited time interval the projectile moves in a straight line at uniform velocity through a homogeneous medium.

3. That the resultant air resistance is parallel to the line of motion of the projectile and passes through the axis of the projectile.

4. That the total resistance is independent of the orientation of the projectile with respect to the tangent to the trajectory.

The problem as thus stated admits a relatively simple solution and the solution is given in complete detail. The student of mathematics will be especially interested in this because it contains an original development of the sine amplitude function and one well suited for purposes of computation. The general conclusions concerning the motion are that for all probable initial conditions, the motion may be either of two kinds. In one, which we shall call motion of the first type, the period of precession is approximately equal to the period of nutation. In the second type, the period of precession is many times greater than the period of nutation. By nutation is meant the variation in the inclination of the axis of the projectile to the tangent to the trajectory, and by precession, the rotational motion of the nose of the projectile about the tangent to the trajectory.

The complicated and rapid oscillations of the projectile and its stability are very important factors in determining the characteristics of its flight. The author has developed this theory in such a way that it may be of greatest service in the design of projectiles. He gives a numerical illustration in which is developed an expression for the stability factor, the relation of this factor to the position of the projectile with respect to the tangent to the trajectory, the period of nutation, and the precessional advance in the period of nutation. These results are illustrated graphically and a method of obtaining this factor experimentally by firing through card board screens is indicated. Further, evidence of experimental firing is presented to show that these firings substantiate the theory.

There follows a general discussion on the stability of projectiles. A practical criterion is developed giving the relation between the rate of spin about the axis of symmetry of the projectile, the ratio of the moments of inertia about this axis and about a perpendicular axis through the center of gravity, and a factor depending upon the moment of the exterior forces. This development indicates the following properties:

1. Other things fixed, the stability is increased by increasing the rate of spin.

2. The stability is increased if the ends of the projectile are lightened so as not to alter the contour.

3. The stability of projectiles fired from guns having the same pitch of rifling is independent of the muzzle velocity.

4. The stability of similar projectiles fired from guns of the same rifling per caliber is independent of the caliber.

5. The stability is less the denser the air.

6. If a projectile is stable when fired at a velocity greater than that of sound, it will be stable if fired at a lesser velocity.

The author also considers the effect on stability of a change in the length of a projectile and the method and necessary modifications for using a light projectile to determine the resistance function.

It is known from actual experience that a well designed projectile stays practically nose on throughout its flight. The theory must give a logical explanation of this fact, but the general motion obtained by means of the original assumptions does not indicate this result. Consequently, the author proceeds to consider the minor factors which enter into the actual problem. Since the accelerations due to these minor factors are small relatively to the accelerations and dynamic reactions that determine the oscillations under the original hypotheses, they may be treated separately.

The rate of spin decreases as the projectile moves along the trajectory. Hence, the author drops the hypothesis that the rate of spin is constant and finds the effects of the forces causing this decrease upon the motion of the projectile. The conclusion reached is that for motion of the first type this couple decreases the stability, and for motion of the second type it increases the stability, but that the effect in either case is small.

Next, the third hypothesis, viz., that the resultant air resistance is parallel to the line of motion of the projectile, is removed. The force acting can be divided into two components, one in the direction of motion of the projectile and another directly opposite to the oscillatory motion. The original differential equations are modified accordingly and it is found that, for motion of the first type, the forces tend to damp out the oscillations and cause the projectile to approach the tangent to the trajectory, while for motion of the second type these forces cause greater oscillations. Further, the effects for motion of the first type are greater than the effects for motion of the second type.

The hypothesis that the projectile moves in a straight line is next removed and the differential equations for motion on a curved trajectory are developed. The problem now presented, except for the hypothesis that the projectile moves at uniform speed during the interval of time considered, represents the actual situation. This hypothesis could also be removed, but the variation from uniform speed for the short interval considered would be so small that the general conclusions would not be affected by its consideration.

It is first proved for the problem as finally stated that a steady state solution exists, that is, that the projectile may move along the trajectory without nutation or precession. It is shown for this solution that the position of the nose of the projectile is a little to the right of, and slightly below, the tangent to the trajectory for guns with right handed rifling. This fact gives a logical explanation of drift. Consideration of the terms introduced due to the curvature of the trajectory show that the oscillations of the projectile are part of the time of the first type and part of the time of the second type. But, since the damping effects are greater when the motion is of the first type, the average effect is to cause the projectile to damp down on to the steady state solution.

This tendency of the projectile to remain nose on is called "trailing." It is obvious that a projectile which is fired with a very high rate of spin will not stay nose on but will tend to maintain the direction in space in which it emerged from the muzzle of the gun. It is thus possible for a projectile to be overstable. Therefore, too great stability is not desired. The practical problem in every special case is so to control the factors which determine the motion through shape, distribution of mass, and the pitch of rifling of the gun that the projectile shall in the first place be stable and in the second place not so stable that it will fail to trail properly. The actual solution can be reached only by experiment interpreted by a complete theory.

Although it is probable that the theories set forth in this book will be adequate for all practical requirements for a long time to come, Professor Moulton concludes his treatise by indicating how the methods that he has developed are capable of being easily extended to meet any needs that may ever arise.

The Eighth Annual Meeting

of the

Army Ordnance Association

Aberdeen Proving Ground, Md.

October 8, 1926

Editorial

Ordnance Day, 1926

THE Eighth Annual Meeting of the Army Ordnance Association—"Ordnance Day," as it has come to be known—will be held at the Aberdeen Proving Ground, Maryland, October 8, 1926. Charter members of the Association will recall the occasion in October, 1919, when a comparatively small group which then comprised the newly formed Association gathered for the first meeting. Since then "Ordnance Day" has become an institution and its significance has transcended even the fondest hopes of the founders.

This year, as in the past, other national organizations have been invited to share with the Army Ordnance Association in the extensive program of tests which have such attractive appeal to all. Through the courtesy of the Secretary of War, the Association is privileged to invite—in addition to its own members—The National Association of Manufacturers, The Reserve Officers' Association of the United States, The National Industrial Conference Board, and The American Society for Steel Treating. Officials of each of these organizations have been asked to contribute articles on the aims and purposes of their respective bodies. These articles appear in this, The Annual Meeting Number, of ARMY ORDNANCE.

It is "altogether fitting and proper" that such societies should join with us on Ordnance Day. He who would deny that American Preparedness and American Industry are closely related lacks the same appreciation of fact as did the old Breton peasants who, in days gone, would have none of the newly invented steam engine. It will be remembered that those unlettered *bourgeoisie* classed the steam engine as an invention of the devil, arguing that the Creator, having made fire and water of such contrary characteristics, never intended that they be brought together to generate steam. Not so long ago, and within the memory of all of us, the business of defense was considered the job of the soldier and of him alone; guns and powder were his forte, and little heed was given by anyone outside the profession of arms to the transcendent question of preparedness. "Watchman, what of the night?" had little or no meaning for such individuals in matters of national preparedness. National Defense was an Army and Navy job, and God help both services if they failed when the call came.

But today how different? "To provide for the common defense" has become the patriotic duty not only of the professional soldier but of every citizen regardless of his walk of life—doctor, lawyer, merchant, chief, all have their place in our present scheme of preparedness against war.

Therefore, the participation of the invited societies in the Eighth Annual Meeting of the A. O. A. means a reaffirmation of interest in the existing scheme of things. It means, too, that American industry as represented by The National Association of Manufacturers, The National Industrial Conference Board, and The American Society for Steel Treating, is cognizant of its duties and responsibilities in the realm of preparedness. It means that The Reserve Officers' Association of the United States values munitions preparedness in its patriotic endeavors for manpower preparedness. And above all, it means an enlightened citizenry to whom the implements of defense are not curios fit only to grace the town museum or bedeck the hero's statue on the common. It means that civilian industry understands its share of the job of defense should it ever be necessary to undertake it.

The Aberdeen Proving Ground

AN ENTHUSIASTIC visitor at one of the annual meetings of the Army Ordnance Association after even the superficial inspection which a day at Aberdeen affords classified the place as "the eighth wonder of the world"! To be classed with such ancient praiseworthies is laudation indeed.

Maybe the glamor and fascination of Ordnance under test is responsible for so high a tribute. But in this day of many wonders one is treading on thin ice when he attempts to classify any object as the ultimate development in its field. Not 25 years ago G. K. Chesterton, brilliant essayist, declared the hansom cab to be the height of locomotive development of the twentieth century, and already one such cab reposes in a London museum—an antique. For this enthusiastic visitor to acclaim Aberdeen a model proving ground would have been more to the point. To have given it place with the other scientific establishments of the world would have been just praise. For Aberdeen is, without doubt, all of that.

We have visited great laboratories and plants where research and tests were under way. But practically all of them are devoted to some one branch of science. At one chemistry will be the field of endeavor; at another electricity; at another metallurgy; at another mechanics. But at Aberdeen many phases of scientific investigation are tested. And as the Proving Ground includes practically all fields of technical research, likewise does it exceed in interest and appeal most other scientific establishments. To determine the velocity of powder and the brissance of explosives is one thing; to determine the stresses and strains on a gun barrel is quite another; to calculate the effect of design and shape of a projectile on its traveling power is yet another, and so on through the hundred and one categories of engineering research connected with the design and manufacture of Ordnance—that all embracing term.

Elsewhere in this issue, the Commanding Officer of the

Proving Ground, Lt. Col. C. M. Wesson, Ord. Dept., U. S. A., describes the important place Aberdeen Proving Ground fills in the operation of our peace-time Army. Also in this issue, Maj. Arthur W. Ford, Ord. Dept., U. S. A., Chief of the Ballistic Section at Aberdeen, discusses some of the more scientific investigations that have been and are now conducted there.

Those who have visited the Proving Ground are, in a measure, familiar with its principal activities. Those who will visit Aberdeen for the first time on "Ordnance Day" this year have a treat in store for them. Young and old alike find fanciful fascination in the exhibits, the demonstrations and the weapons.

Those who in their foresight established Aberdeen Proving Ground at its present site and who designed it on such a huge scale deserve well merited praise. Those who have been charged with its operation—and especially those who have conducted the tests and experiments which have gone a long way in the development of modern American Ordnance—all are worthy of the acclaim and gratitude of munitions devotees throughout the land.

Professor Moulton's Book

THE output of American publishers since the World War presents a fertile field for analysis. Leaving aside the endless grind of fiction, one finds, on general investigation, an apparent awakened public interest in historical and economic subjects.

In the field of "Reminiscences" it is but natural that the cataclytic period 1914-1920 should produce the memoirs of many who were thrust upon the stage of world affairs. National defense has of necessity occupied a considerable portion of these. What major emergency of the past offers the printed chronicle for posterity equal in quantity to that of the World War period?

But in the more restricted field of "pure" Ordnance the last few years have offered little. We have had excellent treatises of the industrial aspects of modern war, to be sure. Tacties in modern battle, too, have been well presented.

But since Tschappat's *Ordnance and Gunnery* there has been a noticeable lack of publications in English on theoretical subjects except, of course, the noteworthy edition of *Handbook of Ballistics* by Cranz and Becker gotten out by His Majesty's Stationery Office, London, and such treatises as American *Coast Artillery Matériel*, and *Theory and Design of Recoil Systems and Gun Carriages*, and others published by the Ordnance Department, U. S. Army.

Little wonder then if the recently announced work of Prof. F. R. Moulton, professor of mathematics at the University of Chicago, entitled *New Methods in Exterior Ballistics* finds many interested readers. A review of this volume is presented by Capt. James L. Guion, Ord. Dept., U. S. A., in this issue of ARMY ORDNANCE.

It is not to the intrinsic merits of the book that we would refer here. The distinction of the author as mathematician and astronomer, and his far-famed work as Lieutenant Colonel of Ordance in charge of ballistics during the World War are ample warranty of the soundness of his theories. The point we would make, however, is this: ballistic theories are not usually gloated over as one sips his morning coffee nor does the *ignoble volus* rush for such an ingenious treatise as it does for a baseball extra. He then who gives of his time and thought to new methods of exterior ballistics performs a service the merit of which is truly great. For, as Carlyle said, he offers "the tools to him that can handle them," and they are tools which are not capable of quantity production.

Picatinny Arsenal Revisited

WERE we inspired by some poetic muse as was the immortal Gray when he revisited his much cherished Eton, surely a return to Picatinny Arsenal after its devastation as a result of the Lake Denmark explosion might bring forth an epic comparable with Blenheim or Austerlitz. But the poetic muse seems to dole her whisperings less sparingly today than in days past, and for us a visit to Picatinny conjures more practical reflections than can be told in poetry.

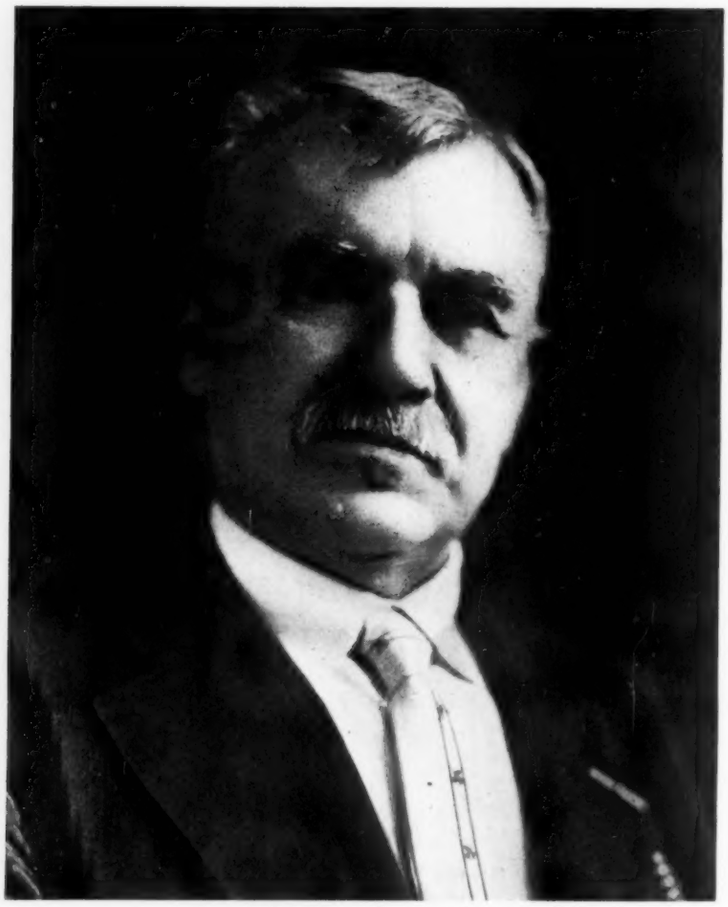
Picture a huge establishment which after a gradual growth of some forty years had attained a high place of perfection as the sole powder manufacturing establishment of the Army. Here is kept alive a knowledge of the technique of smokeless powder production. Include the several areas where experimental and development work on all phases of ammunition manufacture are carried on; include also the other production areas where powder and explosives are loaded and assembled into complete rounds—and you have a composite view of Picatinny.

Come now to the Denmark explosion. Caption writers for the movies would describe it with a half-dozen exclamation marks. Words seem to have little meaning, so we borrow the caption writer's license and use exclamations. Col. W. H. Tschappat's article in this issue of ARMY ORDNANCE gives an extremely authentic account of some of the effects of the explosion upon Picatinny.

This much, however, we would emphasize—today Picatinny is carrying on. Crippled and handicapped she perseveres in the important task of supplying the Army with ammunition. Her spirit is well typified in an incident which occurred three days after the blow. From the power plant with its gaping walls came the regular sound of the factory whistle at noon giving renewed *esprit* to the loyal workers. Few knew at the time that an arsenal locomotive had been backed up to the plant and a line of hose carried steam to the siren! Makeshift offices were thrown together, tottering walls pulled down, and the business of the day—supplying the Army with ammunition—was under way.

Picatinny Arsenal needs much rebuilding and repair. All friends of adequate preparedness will watch with interest the speed of the Congress in appropriating funds for the rehabilitation of this vital Ordnance establishment. Here is one phase of Army supply that cannot get behind schedule. The task of rebuilding the arsenal where destruction is complete and of repair where only that is necessary is one of the most important Army matters that will come before the next Congress. Let us hope that prompt action will foreshadow a revived Picatinny even better and greater than the old.

Retires After 49 Years of Loyal Service



NATHAN HAZEN
Chief Clerk, Office of the Chief of Ordnance

WAR DEPARTMENT
OFFICE OF THE CHIEF OF ORDNANCE
WASHINGTON

August 20, 1926.

OFFICE MEMORANDUM No. 316

1. The retirement, under the provisions of existing law, effective this date, of Mr. Nathan Hazen, Chief Clerk, Ordnance Office, is announced.

2. Born in the State of Pennsylvania on May 30, 1849, Mr. Hazen came to Washington and obtained employment in the Government Printing Office, August 1, 1877. He entered the service of the Ordnance Department as Sergeant of Ordnance, August 12, 1879, and was transferred to a civilian clerkship in the Ordnance Office, August 8, 1882. Passing through the various grades he was appointed Chief Clerk of the Office, March 1, 1918, which position he filled until the date of his retirement.

3. Mr. Hazen's vast store of knowledge of departmental matters, acquired during a lifetime of service with the Ordnance Department; his willingness at all times to place this knowledge at the disposal of those seeking his advice; his untiring devotion to duty, and his uniform courtesy to all with whom he came in contact made for him a host of friends who will regret his passing from active service. Mr. Hazen carries with him the Department's best wishes in his well-earned rest after long, faithful and meritorious service.

Major General, Chief of Ordnance.

OFFICIAL:

C. T. HARRIS, JR.,
Major, Ord. Dept.

Personnel

Edited by Major John A. Brooks, Jr., Military Personnel Section, Office of the Chief of Ordnance

Nathan Hazen, Chief Clerk, Office of the Chief of Ordnance, Retires

ON August 12, 1926, Nathan B. Hazen, Chief Clerk, Office of the Chief of Ordnance, completed 47 years of service with the Ordnance Department and 49 years of service to the Government, having first entered the civil service August, 1877. Mr. Hazen retired under provisions of existing law, August 20, 1926. He is a charter member of the Army Ordnance Association. Maj. C. E. McRae, Ord. Res., former Chief of the Finance Contact Section, Office of the Chief of Ordnance, has been appointed to the Chief Clerkship to succeed Mr. Hazen.

Entering the Department August, 1879, Mr. Hazen served uninterruptedly in various responsible positions in the Ordnance organization.

At the beginning of his service with the Department, Brig. Gen. A. B. Dyer, U. S. A., was Chief of Ordnance. Mr. Hazen was therefore associated with subsequent officers who held that high post, including such preeminent names as Brig. Generals S. V. Benet, D. W. Flagler, A. R. Buffington, Maj. Gen. William Crozier, and the present Chief of Ordnance, Maj. Gen. C. C. Williams.

Upon his retirement as Chief of Ordnance, 1918, General Crozier wrote to Mr. Hazen:

"Leaving the Ordnance Department, I want to say to you that since I entered the office of the Chief for the first time, 31 years ago, finding you already there, I have personally known of your constant and faithful attention to your duty, and I have highly appreciated not only your own services but also the example of industry and right living which you, in your own person, have always placed before the rest of the force."

Of his lengthy and meritorious service, Maj. Gen. C. C. Williams, Chief of Ordnance, said, "His services in the Department have not only been marked by virtue of their faithfulness but also by reason of his inherent executive qualifications. The fact that he is now Chief Clerk of a Department whose employees in general have been faithful bespeak much for his ability to handle these matters placed in his care. In this connection the greatly expanded Ordnance Department placed larger and additional responsibilities on its chief clerk. During the earlier days of the World War Mr. Hazen most efficiently assisted in the necessary reorganization."

His is a record of long and faithful service. Admired and respected by the many with whom he came in personal and official contact, let us express the hope that Mr. Hazen will find with:

"How blest is he who crowns in shades like these
A youth of labor with an age of ease."

Rock Island Arsenal Reserve Officers' Training Camp, 1926

THE Reserve Officers' Training Camp was held at Rock Island Arsenal, July 11-25, 1926. Seventeen Reserve Officers were present.

As visitors to the Rock Island Arsenal the officers were very much impressed by the size, equipment and material stored at the Arsenal. This was indelibly impressed on their memory by their long hikes to the various points of interest on the Island. By the time the group of officers had tramped from one end of the Island to the other, visiting the various buildings they were all ready to admit it is one of the largest Government Arsenals in the world. As cross-country hikers, they were prepared to vouch for the physical fitness of the Director of Training, Maj. F. A. Englehart, Ord. Dept., U. S. A.

The visit to the Savanna Proving Ground afforded an opportunity for the officers to see the vast stores which are held there in reserve and made them realize the magnitude of the preparations made there for any future emergency. The "side door" Pullman used to convey the officers from the barracks to the magazines afforded much amusement as the car bumped along on several flat wheels. The officers of this year's class, feel if the training of future classes is to include the Savanna Proving Ground more suitable accommodations should be provided.

The trip to Savanna was made in automobiles with a stop *en route* at Clinton, Iowa, both going and coming, where everyone relished a chicken or steak dinner.

The course was made more interesting by the lectures of Major Harmon and Captain Wells, on the development work in artillery, tanks, trailers and tractors which were illustrated with motion pictures and the stereoptican.

In addition to the above, the actual experimental work now going on at the Arsenal was of great interest to the officers, and was made more so since Lieuts. Proske and Evans, of Rock Island Arsenal, were members of the class and were assigned as instructors in this work.

The officers of this year's class feel if the training of where ample accommodations made the stay very pleasant. Study rooms were well arranged with an ample supply of Ordnance Department handbooks and technical regulations. Meals, for which special arrangement had been made in the cafeteria, were most excellent at all times and added greatly to the comfort and satisfaction of everyone.

Throughout the course the Reserve Officers displayed enthusiasm in the work and a tendency to try and get more information and instruction in the various subjects than the time allotted would allow. The considerate attitude of every officer and civilian instructor made the subjects very interesting. Every lecture course class and

Reserve Ordnance Officers Who Attended Rock Island Training Camp, July 11-25, 1926.

Front Row, left to right: Capt. Joseph M. Michaelson, Ord. Res.; Capt. Wm. C. Bliss, Ord. Res.; Maj. Frederick A. Lorenz, Ord. Res.; Maj. Francis A. Englehart, Ord. Dept.; Lt. Col. Hardee Chambliss, Ord. Res.; Col. David M. King, Ord. Dept.; Maj. Kenneth B. Harmon, Ord. Dept.; Maj. Philip G. Blackmore, Ord. Dept.; Capt. Leland A. Miller, Ord. Dept.; Capt. Elmer C. Goebert, Ord. Dept.; Capt. Ralph A. Gregory, Ord. Res.; Capt. Harold W. Evans, Ord. Res.; Capt. Gordon M. Wells, Ord. Dept.

Back Row, left to right: 2nd Lt. John F. Nickell, Ord. Res.; 2nd Lt. Erling A. Arentz, Ord. Res.; 1st Lt. Wm. H. Bruhn, Ord. Res.; 1st Lt. Louis B. Armbrecht, Ord. Res.; 1st Lt. Clifford A. Frazer, Ord. Res.; 1st Lt. Lester C. Dibble, Ord. Res.; 1st Lt. Joseph Proske, Ord. Res.; 1st Lt. Herbert H. Mitchell, Ord. Res.; 2nd Lt. Joseph E. McCaughey, Ord. Res.; 2nd Lt. Fred L. Tanner, Ord. Res.; 2nd Lt. Edward G. O'Rourke, Ord. Res.

period of instruction was covered by carefully prepared outlines and question sheets. The notebooks kept by all officers covered notes on the classes and included answers to questions. Taking into consideration the fact the members of the camp were usually up and about at 5:45 A. M., and were kept to schedule all day until 3:30 P. M., there was little time to enjoy recreation on the Arsenal Golf Course.

On Thursday evening, July 22nd, a "dutch treat" dinner was given at the Rock Island Arsenal Golf Club where all of the Regular and Reserve officers at the Arsenal enjoyed a good dinner. After dinner the officers were the guests of Col. D. M. King in the gardens surrounding his residence and later at his home. The evening was perfect and combined with the hospitality of Col. King, made an enjoyable occasion long to be remembered by all present.

The schedule of instruction included an hour and twenty minute Infantry drill period commencing at 7:00 A. M.

The hours of instruction in Ordnance subjects were from 8:30 A. M. to 11:45 A. M. and from 12:45 P. M. to 3:30 P. M.

The ordnance subjects were as follows:

Subjects	*Hours*	*Instructors*
Greeting and instruction, "Rock Island Arsenal"—Its organization, growth and additional requirements	1	Major Harmon
Tour of inspection about the arsenal	4½	Major Englehart
Mobile Artillery	9¼	Major Harmon
Small Arms and Machine Gun firing	3¼	Captain Miller
Small Arms and Machine Guns	3¼	Captain Miller
Field Service Activities	6	Major Blackmore
Pistol Practice	5½	Captain Goebert
Fire Control Instruments	2¾	Major Englehart
Tanks, Tractors and Motor Carriages	6	Captain Wells
Chronographs and Proof firing	3¼	Captain Goebert
Ordnance Company—H. M., its equipment and work	2¼	Major Englehart
Organization of the Ordnance Department and the War Department	1	Major Harmon
Ammunition and its storage and transportation. Surveillance Tests and Powder Laboratory. Savanna Proving Ground—its organization, growth and future use and inspection of its shops	11	Savanna Proving Ground

The group of Reserve Officers was rather small as compared with other years, as there were only seventeen Reserve Officers in attendance. This small group made it very easy to get acquainted and a spirit of friendliness soon became evident and was manifest when the officers parted for their return home on Saturday, July 24th.

The whole course was made so practical and interesting that every one of the Reserve Officers felt the work was very beneficial, both physically and mentally, and expressed a desire to attend the training camps regularly in the future.

The officers who attended the Reserve Officers' Camp at Rock Island were:

Lt. Col. Hardee Chambliss, Ord. Res., 3401 16th St., N. E., Washington, D. C.

Major Frederick Ayres Lorenz, Ord. Res., 7100 South Shore Drive, Chicago, Ill.

Capt. William Carter Bliss, Ord. Res., 1312A McCausland Ave., St. Louis, Mo.

Capt. Harold W. Evans, Ord. Res., Rock Island Arsenal, Illinois.

Capt. Ralph Ailsa Gregory, Ord. Res., 8932 Tudor Ave., St. Louis, Mo.

Capt. Joseph Michael Michaelson, Ord. Res., 3929 Portland Ave., Minneapolis, Minn.

1st Lt. Louis B. Armbrecht, Ord. Res., 411 South Penn St., Wheeling, W. Va.

1st Lt. William Henry Bruhn, Ord. Res., 104 N. Elmwood Ave., Davenport, Iowa.

1st Lt. Lester Cornwell Dibble, Ord. Res., 444 National Bank Com. Bldg., Lincoln, Nebr.

1st Lt. Clifford A. Frazer, Ord. Res., Box 483, Grand Forks, N. D.

1st Lt. Herbert Henry Mitchell, Ord. Res., 1701 Park Road, N. W., Washington, D. C.

1st Lt. Joseph Proske, Ord. Res., 306 E. Garfield St., Davenport, Iowa.

2d Lt. Erling August Arentz, Ord. Res., 1342 Early Ave., Chicago, Ill.

2d Lt. Joseph Erskine McCaughey, Ord. Res., 3301 S. W. 9th, Des Moines, Iowa.

2d Lt. John Ford Nickell, Ord. Res., 2316 Moffett Ave., Joplin, Mo.

2d Lt. Edward Geo. O'Rourke, Ord. Res., 8109 Rielcy Ave., St. Louis, Mo.

2d Lt. Fred L. Tanner, Jr., Ord. Res., 4358 Kenmore Ave., Chicago, Ill.

MAJ. F. A. LORENZ,
Ord. Res.

Reserve Officers' Training Camp, Benicia Arsenal, July 11-25, 1926

AN inspection tour of the San Leandro plant of the Caterpillar Tractor Company, the breaking down and reassembling of pieces of ordnance, practice in firing, inspection of fire control instruments and arsenal warehouses, and a study of explosives and pyrotechnics constituted the outstanding features of the training camp for Ordnance Reserve Officers held July 11 to 25, inclusive, at Benicia Arsenal, California.

The course of instruction and training was arranged by Major S. P. Spalding, assistant ordnance officer at the Presidio of San Francisco, and Major C. E. Partridge, commanding officer of Benicia Arsenal. Actual instruction in paper work and target practice was under the direction of Captain G. Merrill, commanding the 80th Depot Company at the Arsenal.

The reserve officers attending the course included Capt. Chas. W. Aldridge, San Diego, Capt. Donald H. Atherton, Oakland, 2nd Lt. Jesse A. Bell, Marysville, 2nd Lt. M. G. Mauer, San Francisco, 2nd Lt. Lou K. Newfield, Yuba City, 2nd Lt. C. F. Quackenbush, Berkeley, 2nd Lt. Ralph C. Scott, Los Angeles, and 2nd Lt. Wm. Thompson, Burley, Idaho.

Major Partridge made a very interesting and informative talk on Monday, July 12th, in which the organization and functions of Benicia Arsenal were outlined to the reserve officers. This was followed by a talk by Major Spalding who outlined the course of study.

Actual training commenced Monday afternoon and the following schedule was carried out:

1:15 to 4:30	Maintenance Officers: The Pistol. Depot Officers: Routing of Requisitions and Issue of Stores. Company Officers: 59th and 80th Ordnance Company Duties.
	July 13
8:00 to 12:00	Maintenance Officers: The Pistol. Depot Officers: 75-mm. Gun Matériel.
1:15 to 4:30	Maintenance Officers: Caliber .30 Rifles. Depot: Officers: 75-mm. Gun Matériel.
	July 14
8:00 to 12:00	Drill and Military instruction with Ordnance Companies.
1:15 to 4:30	Maintenance Officers: Caliber .30 Rifle. Depot Officers: Fire control instruments, including all principal instruments issued to an Infantry Division.
	July 15
8:00 to 12:00	All Officers: The Rifle.
1:15 to 4:30	All Officers: Rifle Practice.
	July 16
8:00 to 12:00	Maintenance Officers: Automatic Rifle. Depot Officers: 37-mm. gun (Infantry).
1:15 to 4:30	Maintenance Officers: Automatic Rifle. Depot Officers: 6-ton Tanks and 5-ton Tractors. (This included a study of the construction and assembling of this matériel. Each officer maneuvered tank and tractor.)
	July 17
9:30	All officers visited the Caterpillar Tractor Company plant at San Leandro, Calif.
	July 19
8:00 to 12:00	Maintenance Officers: Fire control matériel, including field glass and 80-cm. base range finder. Depot Officers: Pistol.
1:15 to 4:30	Machine Guns.
	July 20
8:00 to 12:00	Machine Guns.
1:15 to 4:30	Machine Guns.
	July 21
	All officers: Drill and military instruction with ordnance companies.
9:00	Inspection of companies under arms.
9:10	Exercise in pitching shelter tents.
10:30	Manual of Arms.
10:45	Infantry drill, including rifle squad and platoon.
1:15 to 4:30	Machine Guns.
	July 22
8:00 to 12:00	Machine Guns.
1:15 to 4:30	Small Arms and Trench Mortar Ammunition, Grenades and Pyrotechnics.

July 23

8:00 to 12:00 Ordnance Maintenance Company Equipment. (Instruction consisted of a study of equipment charts and inspection of matériel issued to heavy and light ordnance maintenance companies.)

1:15 to 4:30 All Officers: *Field Firing*

Pistol	Automatic Rifle
Stokes Mortar	Grenades
37-mm. Gun.	Pyrotechnics
Machine Gun	

July 24

Physical examination; settlement of accounts; clearance.

In addition to the above program, an instructive period was spent during the course in listening to an address by Maj. James Kirk, formerly Division Ordnance Officer at Schofield Barracks, H. T., on "Ordnance Department Activities in the Mid-Pacific." Major Kirk dwelt at length upon the necessity of anticipating the requirements of the various units to be served and recounted the experiences and length of time required before it was possible to accomplish this service. Major Kirk is now stationed at Rock Island Arsenal.

Motion pictures were utilized during the course showing the variations in recoil resulting from different elevations of pieces of heavy ordnance. The films were made at Aberdeen Proving Ground by the Ordnance Department and Signal Corps.

The student officers were trained in dismantling repairing, and reassembling the automatic pistol, caliber .30 rifle, Browning machine gun, automatic rifle, French 75-mm. gun, and 37-mm. gun, as well as binoculars and certain fire control matériel.

L. K. Newfield,
2nd Lt., Ord. Res.

Army Air Service Given New Title

THE branch of the Army establishment charged with the supervision of its aviation activities, which heretofore has been known as the "Air Service," has been officially designated as the "Air Corps" in compliance with legislation passed by the last Congress, it is set forth in a circular recently issued by the Department of War.

A section of the circular (Army Circular No. 45), relating to this change in name is as follows:

"Under the provisions of the act of Congress approved July 2, 1926, published in Section V, Bulletin No. 8, War Department, 1926, the designation 'Air Service' as a branch of the Army of the United States is changed to read 'Air Corps.'"

It was brought out in the circular that it was "not practicable" to revise and republish the orders, Army regulations, and other Department publications so that this change could be made, and that therefore "wherever in any such publication the term 'Air Service' appears as the designation of the branch of the Army of the United States, this term will be understood to refer to the Air Corps."

Captain Demonet Wins Trophy

CAPT. CHARLES DEMONET, Ord. Res., has been selected winner of *The Washington Post* trophy sword by a board of officer sof the Organized Reserves. The sword was given by *The Post* as a trophy to the reserve officer who is considered as having rendered the most effective service in connection with the citizens' military training camps.

The board selected Captain Demonet for his efforts in behalf of the procurement campaign for the camps. Col. Herron, 313th F. A. Res.; Lieut. Col. England, 320th Inf. Res., and Col. Isaac Weil, Ord. Res., comprised the board.

Ordnance Reserve Officers' Training Camp at Aberdeen Proving Ground

THE regular training camp of fifteen days for Ordnance Reserve Officers was conducted this year August 1st to 15th. The course of instruction followed was practically the same as that adopted in previous years with the exception that the morning infantry drill period was increased from 45 to 90 minutes and the sessions of ordnance instruction were reduced from four hours to three hours. Regularly scheduled instruction in pistol practice was also an innovation in the course of instruction. The camp was under the direction of Maj. C. H. Bandholtz, Ord. Dept., U. S. A., Director of Training.

The following Reserve Officers were in attendance:

Lieutenant Colonels: Ballard, Willis D.; Estes, Frederick A.; Guthrie, James.

Majors: Behr, G. E., Dawes, Lyman M.; Goetzenberger, Ralph L.; Graff, Sheldon L.; Ham, William R.; Howard, Langdon W.; King, Edward P.; Mailler, James W.; Merrill, Melville L.; Parker, Ralph E.; Plume, Stephen K.; Pritham, C. H.; Searles, L. W.; Sixsmith, Garnet M.; Smith, Henry J.; Smyser, James S.; Tour, Reuben S.; Whitelegg, R. F.; Zafra, Carlos de.

Captains: Alger, Philip L.; Bevin, Sydney; Bland, Miles C.; Boerckel, James H.; Colborn, John A.; Francis, C. M.; Eliason, Raymond O.; Glancy, Thos.; Goho, Reuben E.; Googins, F. J.; Gould, Herman P.; Hampton, William B.; Higgins, Ralph H.; Lucas, Ernest L.; MacNiven, Frank R.; Marsh, Henry N.; Phillips, Matthew D.; Sarber, Frank N.; Slade, G. P.; Tanner, Paul; Tomasky, George T.; Watts, Cecil Edwin; Woodberry, David L.

First Lieutenants: Bassett, William H., Jr.; Bingham, George W.; Brady, Joseph P.; Burrowes, Hillier McC.; Cox, Burns C.; Frederick, Delancy L.; Hepburn, Norman C.; Herron, Connie R.; Holden, Timothy N., Jr.; Hiller, Charles, Jr.; Holland, Louna W.; Hoon, Joseph B.; Johnson, John H.; Kohn, A. J.; Madgett, John H. F.; Naramore, Stuart; Parker, Harry; Roth, George B.; Ruden, George B.; Saffold, J. Webb; Sill, Norman E.; Van Pattensteiger, W.

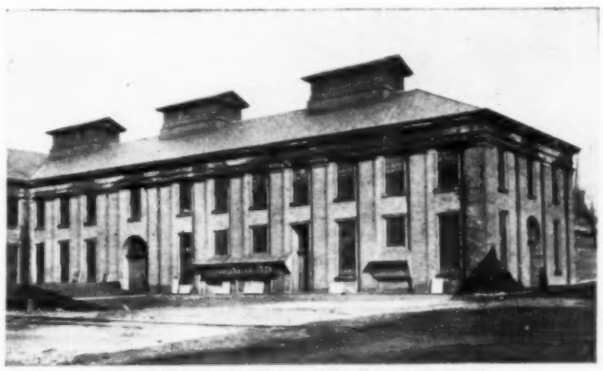
Second Lieutenants: Armstrong, Everett R.; Baker, N. D.; Barnes, Laurence A.; Beaudry, Roy K.; Cummings, Walter W.; Dodson, Williard F.; Elliott, C. W.; Gibbs, Charles J.; Hebard, Frank H.; Karch, Herbert S.; Kiley, L. J.; Krauss, Willard W.; Lepsch, Clem W.; Lyman, Paul W.; Mills, John H.; Moffett, Joseph G. Moulthrop, Henry S.; Muenz, Oscar A.; O'Brien, Thomas A.; Rhodes, Walter J., Jr.; Spengler, C. W.; Stroup, Claude M.; Van Sickle, Roswell C.; Walker, H. T.

Historical

Edited by Maj. William A. Ganoe, Inf., U. S. A., Historical Section, Army War College.

The Passing of Allegheny Arsenal

Allegheny Arsenal, an old Ordnance establishment at Pittsburgh, Pa., has gone the way of many historical Army establishments and soon will be but a memory. The products of this arsenal were well known during the Indian Wars and in the Civil War. In its day Allegheny Arsenal was one of the principal Ordnance establishments for the fabrication of gun carriages, harness, and the manufacture of artillery ammunition.



Gun Carriage Shop, Allegheny Arsenal.

Allegheny Arsenal was a garrisoned post of the U. S. Army until February 24, 1906, when its name was changed to the Pittsburgh Storage and Supply Depot and the post was converted into its present status, jurisdiction being transferred from the Chief of Ordnance to the Quartermaster General.

Allegheny Arsenal has occupied an important position in the annals of the Army. An account of the selection of the site is found in a report submitted to the House of Representatives during the 13th Congress, 1st Session, by the Chief of Ordnance, Col. Decius Wadsworth, U. S. A., in plans for the "Extension of the Ordnance Department," dated June 19, 1813. The report recommended that one of the three principal laboratories and arsenals be placed in or near Pittsburgh. (Ref. *Mil. Affairs*, Vol. I, pages 336 and 337.)

The original site selected was located on the east bank of the Allegheny River which was then Pitts township of Allegheny County, Pennsylvania, containing approximately 30 acres, purchased on April 9, 1814, from William B. Foster. (Report of Lands and Buildings acquired for Military Purposes submitted to 16th Congress, 2nd Session, Doc. No. 203, by Secretary of War, John C. Calhoun. Ref. *Mil. Affairs*, Vol. 2, page 285.)

The selection of this location can readily be traced back to Old Fort Duquesne at the junction of the Monongahela and the Allegheny Rivers, which is now the city of Pittsburgh. In the Braddock Campaign during the battle of June 9, 1755, the British General, Braddock, was killed. George Washington was one of Braddock's staff officers and next in command. Upon his shoulders devolved the extrication of those who had escaped with their lives. This was really the beginning of his matchless military career. During 1770 he visited again the scenes of this battle. Old Fort Pitts was abandoned in 1772 and during the Revolutionary War was again garrisoned by Continental troops.

Pittsburgh has now grown into a city of approximately 800,000 population, and the old Arsenal is located in the industrial center of the city, between 39th and 40th streets, surrounded by many of the leading commercial and manufacturing establishments of the water front section.

There have been several parcels of the above area disposed of. Five acres were transferred to the U. S. Treasury Department, 14.73 acres to the city of Pittsburgh, 4.33 acres for various rights of way, leaving only 13.79 acres for sale.

This depot was declared surplus by the Secretary of War and recommended for disposal. (See H. R. Doc. 148, 67th Congress, 2nd Session, dated January 10, 1922.) The recommendation was confirmed and authority was granted for the sale in accordance with Act of Congress approved July 16, 1922 (Public No. 231, 67th Congress).

Commanding Officers' Quarters, Allegheny Arsenal.

Allegheny Arsenal in its day fought the good fight, it now gives way to the onward march of industrial progress—and passes its honored history and important role on to the more modern arsenals of the present.

Professional

Storage of Recuperators

Preservation in storage of recuperators for 75-mm. Gun Carriage and 155-mm. Gun Carriage.

THE problem of preserving satisfactorily hydro-pneumatic recuperators in storage has caused the personnel at Rock Island Arsenal considerable worry for the past two or three years. The highly polished surfaces of the bores of the recuperators are very readily corroded to the extent that re-lapping becomes necessary. The piston rod of the 75-mm. recuperator also suffers at the point where it enters the cylinder through the stuffing box.

The gas cylinder in which the floating piston moves seems to be peculiarly liable to rust. This is only true of the recuperators charged in this country with nitrogen. The conclusion is that the manufacturers in this country have not been supplying thoroughly dry nitrogen. This subject is discussed separately under the heading "Dry Nitrogen."

The piston rod at the point where it passes through the packing is in contact with leather and some oil. It becomes corroded, due possibly to some residue of tanning acid in the leather or to acidity of the oil resulting from breakdown. It is customary in storage to move the piston farther forward than it ever moves in service, so that the erosion occurs on the section of the rod properly located outside the recuperator. However, it is desirable to eliminate the cause of the erosion, and so experiments are being conducted to develop a different form of packing, composed of inert materials. This is discussed below under the heading of "Metallic Packing."

It is felt that if dry nitrogen can be procured the recuperators can best be preserved in the assembled state. This is highly to be desired, as it is a risky policy to have any great percentage of them torn down. They should be in serviceable condition, ready for any emergency, and the arsenal should not be handicapped in meeting its war-time production schedule by the necessity of first assembling a large number of recuperators.

A test is about to be made of storing recuperators immersed in oil and hermetically sealed in a metallic container.

Dry Nitrogen

Nitrogen as it comes from the fractioning column is practically free from moisture. It contains at this stage about 8% of oxygen. The problem, therefore, is not the production of dry nitrogen but the handling of it in such a way that no moisture is taken up. It is customary to remove the 8% of oxygen by introducing a suitable amount of hydrogen. This necessarily results in the formation of water. The pumps which are used to compress nitrogen into cylinders may be lubricated or sealed with water or oil. If water is used, the nitrogen, by coming in contact with it, naturally becomes saturated. All nitrogen used in 75-mm. and 155-mm. recuperators should be oil pumped. Heretofore it was thought that the presence of oxygen was more objectionable than the moisture resulting from its elimination. The correctness of this assumption is doubted and this arsenal is now procuring nitrogen from which the oxygen has not been removed.

Even though the nitrogen may be oil pumped, there is no assurance that it will be thoroughly dry when received by the consumer, due to the fact that there may already be moisture in the cylinder into which the nitrogen is compressed. This arsenal is taking particular pains to see that all cylinders are thoroughly treated before being sent to the factory to be charged.

At the present time we are securing nitrogen which contains oxygen, which is oil pumped, and which is stored in thoroughly dry cylinders. As an extra precaution these cylinders are being reduced to a temperature below the freezing point at the Ice Plant and are then being inverted and the valves opened in order that any free moisture may be blown off. If any moisture is found to be present it is, of course, an indication that the nitrogen is saturated.

Metallic Packing

Experiments have been conducted, using various types of metallic packing in the recoil mechanism for the 77-mm. Gun Carriage and for the 155-mm. Howitzer Carriage. After trying numerous arrangements a design has been found which has given very satisfactory results during extended proof firings. While the details of the design will not be mentioned here, considerable importance is attached to its success in that its use will eliminate the difficulty being experienced in procuring suitable rubber packing for the 155-mm. Howitzer recuperator and the difficulty incident to deterioration in the 75-mm. recuperator.

Authority to make an extensive test of this metallic packing in a standard 155-mm. howitzer recuperator, as well as to extend the experiments to include the recuperator for the 155-mm. gun, is expected shortly.

KENNETH B. HARMON,
Maj. Ord. Dept., U. S. A.,
Rock Island Arsenal.

The National Rifle Association Range at Bisley, England

BISLEY is a small place about thirty miles southwest of London, and about three miles east of Aldershot. The National Rifle Association is practically independent of the Government and the War Office. It was founded in 1860 to encourage rifle shooting in the British Empire. It now has about 3,000 members, and owns and runs the great Rifle Range at Bisley. The membership dues for a civilian are $5.00 per annum; for soldiers and ex-soldiers $1.25 per annum. Anyone contributing in any one year the

sum of $50.00 or upwards, or the donor of a prize of the value of $100.00 or upwards, is made a life member of the Association. The ground on which the Rifle Range is located originally belonged to the Government and was included in the Aldershot Military Reservation. When the Rifle Association moved its ranges from Wimbledon to Bisley in 1890 the Government furnished the Association with the land it now occupies. The land is well drained but unfit for agricultural purposes and makes an ideal situation for a target range.

Three ranges are provided. The short range has 35 targets, the medium range, 500 and 600 yards, has 100 targets, and the long range, 800 to 1,200 yards, has 50 targets. The target for the 200-yard range has a 12-inch bull's-eye with an inner scoring ring six inches in diameter. For the 300-yard range a 12-inch bull's-eye with a nine-inch inner scoring ring is used, and for 500 and 600 yards the bull's-eye is 24 inches in diameter with an inner scoring ring of 18 inches. All these targets have the lower half of the bull's-eye covered with straw-colored paper, so that the upper half only is visible from the firing line. This results in center point of the horizontal diameter of the bull's-eye being used as the aiming point instead of the bottom point of the vertical diameter, which is used by us. The target at long ranges has a 36-inch bull's-eye, and the lower half is not covered with paper as in the shorter range targets. The scoring is 5 for a bull's-eye, 4 for an inner, 3 for a magpie, and 2 for an outer.

The method of marking is as follows: When the marker in the pit notes the value of the shot on the target he pulls down the target and at the same time elevates a white frame in one corner of which he has placed a black square. If the rifleman has obtained a bull's-eye the square is in the lower right hand corner. For an inner it is in the lower left hand corner. A magpie is signalled in the upper right hand corner and an outer in the upper left hand corner. A miss is signalled by the blank white frame and a ricochet by a black diamond placed in the bottom center of the white frame.

As soon as the scorer has had time to note the value of the shot, the marking frame is pulled down, the target elevated, and on the target is placed a small square showing the exact position of the hit. This square is white on the bull's-eye and black on the rest of the target.

The Rifle Association is governed by a President, elected by the Governing Council. The Governing Council consists of the President, the Treasurer, 30 ordinary members, 3 Co-opted members, and the Ex-Officio members. The Ex-Officio members consist of high officials in the State, Army, Navy and Air Force, and include High Commissioners for the various Colonies, the First Lord of the Admiralty, the Secretary of State for War, Chief of the General Staff, Secretary of State for Air, Chief of the Air Staff, and Commanding Officers of the Great Departments on land, sea, and air. An enormous amount of interest is taken in the Association, and they have no difficulty in persuading various high officials to accept the responsibilities of serving on committees during the meetings throughout the year. When the team from the 107th United States Infantry recently competed against a team from the Queen's Westminster and Civil Service Rifles, Admiral of the Fleet, Lord Jellico acted as chief umpire. The teams were also received by the King, and were given a dinner by the Prince of Wales.

A number of competitions are held throughout the year at Bisley. The Range is very easy of access from London and members desiring to use it have simply to telephone their Rifle Association, which makes the necessary arrangements at Bisley. The cost is quite reasonable, being 60 cents for 24 rounds of ammunition, and the use of a target. At the end of the War the Secretary of the Association had foresight enough to purchase from the Government sixteen million rounds of surplus ammunition. This is sold now to Rifle Associations at $12.00 per thousand rounds. The advantage of this arrangement can be judged from the fact that new ammunition costs about $50.00 per thousand. The Association has about 3,000 affiliated Rifle Clubs scattered throughout the Empire, and puts up annual prizes to be competed for by these Clubs. The Clubs hold their own shoots and send in the results to the N. R. A. at Bisley. Last year 26,000 boys throughout the Empire entered team competitions fostered by the Association. Teams are of 2,000 each, as the Association desires to encourage team shooting rather than have the Clubs concentrate their efforts in developing one or two remarkable shots. The King donates the prizes for these team competitions.

During competition the Government furnishes the ammunition used and allows the Association to requisition a certain number of soldiers to be employed in the pits. The Association pays these soldiers an extra compensation and also pays their transportation to and from the meeting.

The most interesting feature of the installation at Bisley is the provision made for the comfort of its members. A large mess hall with excellent kitchen is provided, where competitors can take all their meals. In addition the Association provides a number of barracks where competitors are lodged in single rooms. The rooms are small, being about ten feet square, but are quite sufficient for the period of a meet.

Certain rifle clubs have their own club houses at Bisley, and these clubs in addition to furnishing meals and sleeping accommodations for members, also furnish convenient places for holding dances, teas and other social functions. The object of the N. R. A. is to interest the wives of members in the various meetings, and the clubs carry out this object very efficiently. The site of the N. R. A., at Bisley, is a small town in itself with a store, restaurants, clubs, postoffice, etc., well paved streets, electric lights, and living accommodations for about six hundred persons. During the large meets the Association erects tents for sleeping and messing competitors who can not be accommodated in the permanent installation. These tents are generally hired from the Government.

The Government has the privilege of hiring targets from the Association for the instruction of soldiers in the Regular and Territorial Army. There are nearly always one or two battalions encamped near the Range and they carry out both rifle and machine-gun firing. The Association charges the Government 75 cents per day for each target used, and furnishes all targets necessary.

The N. R. A. is financed by its own members and also

by donations from various persons interested in promoting rifle shooting.

Meetings at Bisley are very cheery affairs and many persons attend them more for a holiday and a reunion than for the purpose of competing for prizes.—(*Furnished by the Military Intelligence Division, General Staff, U. S. A.*)

"Trigger Pull" of the Army Service Pistol

A STUDY recently made by the Ordnance Department to determine what amount of "trigger pull" pressure for the .45 caliber, model 1911, service pistol, should be considered safe, has resulted in the conclusion that a trigger pull below five pounds is unsafe under average service conditions.

A trigger pull of four pounds, or even less, is considered desirable for marksmanship firing, but it now has been decided by the Ordnance Department that a reduction of such pull to within these limits would result in making a large percentage of pistols mechanically unsafe.

A mechanically unsafe pistol is one which will not stay cocked when the pistol is fired or when the slide is operated by hand, or both. In order to reduce the pull to five pounds or less it is necessary that the "sear" notch of the hammer and the sear nose be altered very materially, either intentionally or through wear.

To permit a reasonable amount of normal wear and yet at the same time to keep the pull above the five-pound limit, the Ordnance Department believes that it should issue no pistol in which the trigger pull is less than 5½ pounds. A previous recommendation having to do with the maximum limit for the trigger pull of pistols which are issued by the Ordnance Department was 7½ pounds. Now, however, it is believed that this limit may be reduced to 6½ pounds, but a reduction below this point is construed by Army officials as not feasible.

The new recommendations made by the Ordnance Department are as follows:

For pistols, as issued, either new or overhauled, not less than 5½ pounds or more than 6½ pounds.

For pistols in the hands of troops not less than five pounds.

Antiaircraft Defense Training

THE Coast Artillery Corps is busy improving antiaircraft defense by means of a series of tests and demonstrations.

The 62nd Coast Artillery (AA) is engaged in field exercises on Long Island, N. Y., testing out various antiaircraft firing devices and mounts.

An extended field test will be held at Aberdeen Proving Ground, Md., beginning September 1, in which various types of armament, searchlights and fire control will be tried out against moving targets under the supervision of the Chiefs of Ordnance and Coast Artillery.

Members of the Coast Artillery Board and representatives from the Ordnance Department, Coast Artillery Corps, Air Corps, Engineers and Signal Corps will attend the tests.

The 61st Coast Artillery Regiment, Fort Monroe, Va., will be sent to Aberdeen Proving Ground to participate in the test. The fire control section of the 62nd Coast Artillery Regiment will be sent from Long Island at the conclusion of field maneuvers to take part.

Issue of Black Powder in Bulk Discontinued

WAR Department Circular No. 46 which was issued recently, announced that the issue of black powder in bulk to line organizations of the Army will be discontinued and instead charges for blank ammunition for cannon and for smoke puff outfits will be issued by the Ordnance Department.

All posts where the present stock of black powder in bulk is in excess of 100 pounds, the department has ordered that arrangements be made immediately "to return all the bulk powder to an ordnance storage depot and to supply charges for blank ammunition and for smoke puff outfits made up in suitable containers." The order in Circular 46 also declared that the Army regulation having to do with salutes and ceremonies is being revised in conformity with this new policy.

The full text of the instructions, as contained in Army Circular No. 46, follows:

"Instructions for the preparation and use of blank ammunition for cannon. Section V, Circular No. 22, War Department, 1926, is amended by changing paragraph 1 thereof to read as follows:

"'1. On account of accidents that have occurred in service in the handling of black powder in bulk, the issue of black powder in bulk to line organizations will be discontinued. Charges for blank ammunition for cannon and for smoke puff outfits, made up in suitable containers, will be issued by the Ordnance Department. In order, however, to reduce the number of small shipments which would be necessary if all black powder was returned to ordnance storage depots, post ordnance officers of posts at which the amount of black powder in bulk now on hand does not exceed 100 pounds, may retain their present stock for use in blank ammunition and smoke puff outfits. At posts where the present stock of black powder in bulk is in excess of 100 pounds, Corps Area and Department Ordnance Officers will make immediate arrangements to return all the bulk black powder to an ordnance storage depot and to supply charges for blank ammunition and for smoke puff outfits made up in suitable containers.'

"Paragraph 11, AR 600-25 (Salutes and Ceremonies), now undergoing revision, and TR 1360-A covering the preparation and use of blank ammunition for cannon, in course of publication, have been prepared in conformity with this new policy."

Theater of Operations

Edited by Maj. T. A. Clark, Field Service, Office of the Chief of Ordnance

An Outline of Ordnance Service in the Infantry Division

Lt. Col. Edward L. Sherwood, Ord. Res., U. S. A.

THE following article was one of several covering the functions performed by the various members of the General Staff and of the Technical, Supply and Administration Group of an Infantry Division Staff, and was read on August 18, 1925, *at a conference of the officers of the 78th Division Staff on active duty for fifteen days' training as a Division Staff at Camp Silzer, Sea Girt, N. J. Comment and discussion are invited.*

IT IS perhaps best to state generally at the beginning of this brief discourse on the functions and inter-staff relations of the Division Ordnance Service, that the term "Ordnance" refers to fighting equipment—arms and ammunition except that peculiar to Chemical Warfare, nor does it cover Engineer explosives such as triton, dynamite, or bangalor torpedoes, and in the Division, the procurement of artillery ammunition, as a rule, is the responsibility of the Artillery Brigade Ammunition Officer.

The Division Ordnance Officer or his assistant arranges with the proper depot for the original outfitting or refitting of the Division with its fighting equipment and issues normal replacements from spare parts, and extra equipment carried by the Ordnance Maintenance Company with the Division.

It should be borne in mind that the mission of the Division Ordnance Officer is to see to it that there is complete fighting equipment for all units of the Division and that such equipment is at all times in prime condition for effective use in so far as his own endeavor can assure this. By fighting equipment, we mean, cannon, tanks, machine guns, rifles, bayonets, pistols, bombs, grenades, pyrotechnics and ammunition of all kinds, also sound and flash ranging devices, optical glasses, fire control instruments, etc.

The personnel of the Ordnance Service in a Division includes nine commissioned ordnance officers; two of these are assigned to the Division Staff to the Technical, Supply and Administrative Group (the Division Ordnance Officer and his assistant); the remaining seven are company officers for the Ordnance Maintenance Company of the Division, which has an enlisted strength of 105 men.

The technical employment or utilization of this company is controlled by the Division Ordnance Officer and is his definite responsibility. The Company, however, is part of the special troops of the Division, and for administrative and disciplinary purposes is under the command of the Commander of Special Troops of the Division.

The enlisted men of the company are mostly technical specialists who are armed and drilled as a rifle company of Infantry and thus provide their own security when necessary.

The normal replacement of fighting equipment is accomplished through the supply section of the Ordnance Maintenance Company except ammunition which is not carried in the Ordnance Section of the Division Train.

Except for the limited repair facilities of the Quartermaster Train and the Tank Company, there is not any other Maintenance Unit in the Division. The Quartermaster counterpart of this maintenance is not a Division unit.

As only the Ordnance Service has such a completely equipped repair shop in the Division, there is a tendency to regard it as a kind of general service station, and while maintenance work other than Ordnance is not usually invited, in the late war commanders frequently demanded such work of the Ordnance Service, who were thus called upon to do all manner of miscellaneous emergency repair work, including many ill-advised requests which should have been discouraged; but the helping hand of the Ordnance Maintenance Service, we hope, will always be there if the emergency is great enough.

The Division Ordnance Officer is also the munitions officer for infantry ammunition and sometimes for artillery ammunition, although the Artillery Brigade Commander usually designates an artillery munitions officer from his own command.

The Division Ordnance Officer is an advisor on matters relating to the physical condition of the Ordnance equipment and supplies used by the Division, and he is consulted on such matters by the Commanding General and his staff. If he is a mechanical engineer, his duties, especially supervision of the operations of the repair shop, will be much easier for him.

The duties outlined for this officer as described in the General Service Schools publication, *Command, Staff and Logistics*, are as follows:

"(1) To distribute to all concerned, necessary technical information about ammunition, including artillery ammunition.

(2) To collect and study enemy ordnance of all kinds and report his findings to the proper authorities.

(3) To inspect at proper intervals all ordnance material in the division to ascertain its degree of serviceability.

(4) To see that all units of the division are informed as to the location of Ordnance supply and repair facilities and are properly performing their duties in connection with ordnance supply and maintenance.
(5) To visit subordinate commanders to determine what difficulties and deficiencies exist, so that he may take steps to correct and eliminate them.
(6) To control the operations of the ordnance company (maintenance).
(7) To investigate, inspect and provide for the proper disposition of all accumulations of unserviceable ammunition, including artillery ammunition and duds, found in the Division area.
(8) Recommend locations for infantry ammunition distributing points."

His relations with the G Staff are largely as follows:

G-4. Control of all Infantry Ammunition, Ordnance and Ordnance supplies, and arranging the transportation therefor.
G-3. Advisor on status of ammunition supply for Infantry and as to physical status of fighting equipment of any unit or units (which he has learned by inspection and observation), also to forecast probable requirements for Infantry ammunition.
G-2. Collection, study and reports on enemy fighting equipment and ammunition.
G-1. Personnel matters.

His inter-staff relations with other officers of the Technical Supply and Administrative Staff are roughly as follows:

(a) Commanding Officer of Special Troops regarding administration of the Ordnance Maintenance Company, also regarding details necessary from Service Company in connection with Infantry Ammunition Supply.
(b) Chemical Warfare Officer with regard to handling Chemical Warfare Ammunition or grenades and the study of enemy specimens.
(c) Air Service Officer on Maintenance and Inspection of Ordnance equipment on airplanes.
(d) Tank Officer—Repair and Inspection of tanks (Tank Company does its own maintenance), also Ammunition Supply.
(e) Machine Gun and Howitzer Officer, Maintenance and Inspection and Ammunition Supply.
(f) Inspector General regarding inspection where conditions are not satisfactory as to care of fighting equipment and as to accidents such as premature fire in dumps, explosion, etc.
(g) Division Adjutant—Personnel and Records.
(h) Commander of Quartermaster Trains on transportation problems.
(i) Judge Advocate General on purchase of emergency facilities.
(j) Finance Officer on purchase of emergency facilities and matters regarding pay.
(k) Signal Officer on communication facilities.
(l) Artillery Brigade Ammunition Officer on recommendation for small arms ammunition distributing points for Artillery Brigade.
(m) Engineer Officer—possibly regarding data on weights of heavy Ordnance in connection with bridge building and road repair, also possibly on demolition of ammunition dumps.

There is very little, if any, contact maintained with other officers of the Technical Supply and Administrative Group.

In closing, it is earnestly hoped that discussion may be had on this resumé of the Division Ordnance Service, especially by those officers who had service with Divisions in France during the World War.

Who's Who in This Issue

LT. COL. C. M. WESSON, Ord. Dept., U. S. A., Commanding Officer, Aberdeen Proving Ground, Md., is a graduate of the United States Military Academy and of the Army War College. He was awarded the Distinguished Service Medal for meritorious service in the World War.

Mr. D. M. Edwards is the editor of *American Industries*, the journal of the National Association of Manufacturers.

Magnus W. Alexander is President of The National Industrial Conference Board.

Brig. Gen. John Ross Delafield, Ord. Res., U. S. A., is former Chief of the New York Ordnance District and past president of The Reserve Officers' Association of the United States.

Maj. Arthur W. Ford, Ord. Dept., U. S. A., is Chief of the Ballistic Section, Aberdeen Proving Ground. He was formerly an instructor in Ordnance and Gunnery at the U. S. Military Academy.

Col. William H. Tschappat, Ord. Dept., U. S. A., is Chief of the Technical Staff, Office of the Chief of Ordnance. He was chairman of the board which investigated the damage done Picatinny Arsenal by the Lake Denmark explosions.

Capt. James L. Guion, Ord. Dept., U. S. A., is one of the officers detailed to study ballistics, mathematics and physics under the direction of Prof. F. R. Moulton at the University of Chicago.

Patents

Brief Descriptions of Inventions of Interest to Ordnance Engineers

Compiled by W. N. Roach, Chief, Patent Section, Office of the Chief of Ordnance

THE most interesting of the recently issued patents relating to Ammunition are the following:

Capt. James C. Vickery, Ord. Res., and Lieut. Merle H. Davis, Ord. Dept., U. S. A., have been granted patent No. 1,579,262 for a process for drying smokeless powder. The process consists essentially in drying the powder in an atmosphere partially saturated with the same solvent that it is desired to remove from the powder.

Patent No. 1,579,964 has been granted to Dr. Walter O. Snelling, assignor to Trojan Powder Company for an explosive. The invention covered by this patent consists in admixing a non-explosive toxic-lachrymatory, a smoke producing material, with a detonating material, preferably nitrostarch. By an intimate admixture of the substances much greater dispersion of the materials is secured.

Hans Rathsburg has been granted patent No. 1,580,572, for the manufacture of detonating compositions. The compositions forming the subject of this invention are intended especially for primers. The compositions contain basic salts of tetrazol compounds.

Charles R. Franklin, of Picatinny Arsenal, has been granted patent No. 1,582,256 for a propellant powder. The invention consists in providing a nitrocellulose powder containing nitroguanidine, and an oxidizing agent, which has its surface impregnated with a deterrent or non-hygroscopic material.

Patent No. 1,583,895 has been granted to Robert C. Moran, assignor to E. I. du Pont de Nemours & Co., for a nitroglucoside explosive. The explosives made from nitrated glucosides are comparatively cheap, stable and low freezing explosives.

Bohdan Pantoflicek has been granted patent No. 1,585,686 for a fuze for projectiles. The invention consists in providing a casing with a series of fuzes, shown arranged axially of the casing, each individual fuze compressing a body and two firing elements, each body carrying one of the elements of the next succeeding fuze.

Patent No. 1,586,380 was issued to Hans Rathsburg for a primer composition. The compositions forming the subject matter of this invention contain guanylnitrosaminoguanyltitracene.

Doctor Snelling, assignor to Trojan Powder Company, also has been granted patent No. 1,588,277, for an explosive. The main objects of this invention are to secure greater dispersion of toxic or other inert materials and to reduce the tendency of such materials to decompose at the moment of explosion or detonation. These objects are attained by intimately admixing the inert materials with nitrostarch or other explosive and an oxidizing agent.

Capt. Samuel Wiley, of Pacitinny Arsenal, has been granted patent No. 1,588,639 for an emergency landing flare. The invention covered by this patent comprises a flare formed of two cases, one of which contains an illuminant, and the other a parachute connected to the flare casing by a flexible connection, the two cases being separable when launching to permit operation of the device.

Patent No. 1,589,237 has been issued to Allen E. Scott, deceased, for an explosive mixture. The object of the invention appears to be the production of an explosive which may be used as a blasting explosive, a charge for heavy ordnance, or for small arms. The explosive is made by dissolving picric acid, alum, and an ammonium compound, in hot water, and then crystallizing out. When prepared for blasting potassium chlorate is sometime added.

Captain Wiley also has been granted patent No. 1,589,277 for an emergency landing flare. This patent covers a specific construction of flare in which the ignition is caused through the suspending means by inertia of the body upon opening of the parachute.

Patent No. 1,590,290 has been granted to Capt. Dale C. Hall, Ord. Dept., U. S. A., for a shell or projectile of the armor-piercing type. The invention consists of a shell base threaded to the shell, the resistance of the threads to strain being less than that of the body of the shell.

Edwin Taylor, assignor to Taylor Laboratories, Inc., has been granted patent No. 1,590,598, for making smokeless powder and the like. This process consists in forming a solution of cellulose material, removing the solvent by electrolysis and then nitrating the resulting product, also in so forming the material, and then coating with a material having a slower rate of burning.

Artillery

The following patents pertaining to artillery have been issued recently:

Nicholas E. Methlin, assignor to Schneider & Cie., has received patent No. 1,578,751 for an apparatus for producing hooping effects in metal tubes of great strength. The invention consists in providing spherical members for closing the ends of the tube while subjecting it to internal pressure. By providing such closures, areas at the ends of the tube not subjected to pressure are avoided.

Bryan P. Joyce, formerly of Rock Island Arsenal, has been granted patent No. 1,579,484 for an adjustable axle pivot pin for gun carriages. This patent covers a pin which may be turned to alternate positions for the purpose of connecting the axle rigidly to the carriage when in firing position or disconnecting it when in travel posi-

tion, together with means for holding the pin in alternate positions.

Patent No. 1,580,652 has been granted to Arthur T. Dawson and George T. Buckham, assignors to Vickers, Ltd., for a gun carriage. The invention consists in the provision of a fore carriage and limber to which the trail of a heavy field gun may be connected for travel, the carriage being provided with a demountable crane through which the trail may be lifted to position on the carriage.

Paul Kaminski, assignor to Siemens and Halske, Aktiengesellschaft, has been granted patent No. 1,581,268, for a means for correcting errors in gun training devices. This is an arrangement for directing gun fire of the telecontrol transmission type in which specific means for correcting error have been incorporated.

Arthur T. Dawson and George T. Burkham, assignors to Vickers Limited, have received patent No. 1,581,793 for a sighting apparatus for antiaireraft ordnance. This invention relates to a sighting apparatus in which the lateral movements of the sight relatively to the gun occur in the plane of the sight at all angles of elevation, and in which a mechanism is provided for giving or indicating the required correction to the vertical deflection setting when the sight is adjusted for lateral deflection, the correction being made dependent upon the amount of lateral deflection and the angle of sight.

Patent No. 1,582,760 also has been granted to Bryan P. Joyce for a counterpoise. The invention relates to a counterpoise so constructed and mounted as to vary the effective force of the counterpoise in proportion to the variation in the opposing force of the pivoted body or gun.

Mr. Joyce has also been granted patent No. 1,582,759 for a counter recoil regulating mechanism. This invention relates to a specific form of valve and valve casing for varying the return flow of liquid in a recuperator.

Archibald Barr and William Stroud, assignors to Barr & Stroud, Limited, have been granted patent No. 1,583,439 for an apparatus for the control of gun fire. The invention relates to the electrical transmission of indications from a range finder to a fire control station.

Eugene Schneider, assignor to Schneider & Cie., has been granted patent No. 1,583,858 for a gun mounting, laying and sighting arrangement for artillery on aeroplanes.

Nicholas E. Methlin, assignor to Schneider & Cie., has been granted patent No. 1,584,182 for a corrector for fire control systems. This invention relates to a corrector designed more specifically for introducing the required corrections in controlling gun fire from ships or like moving platforms.

Patent No. 1,584,946, for a gun carriage, has been granted to Bryan P. Joyce, assignor to Thomas H. Conlon, Office of the Chief of Ordnance. The invention has reference to an elevating mechanism and a top carriage for infantry accompanying guns.

James B. Henderson has been granted patent No. 1,586,741 for a range finder. This invention relates to a means for stabilizing the optical system; e. g., the prisms, rather than the whole range finder. This range finder is intended for use on ship board or other moving vehicles.

Otto Oppenstein, assignor to Bausch & Lomb Optical Co., has been granted patent No. 1,589,132, for a telemeter. The invention consists in providing a simple form of base line telemeter in which the base line may be brought to the value zero so as to be able at any time to carry out a correction with the aid of any distant object.

Patent No. 1,589,194 has been granted to George S. Maxwell for a muzzle loaded mortar. The invention aims to provide a rifled mortar and a shell therefor having a rotating band but capable of gravity loading and firing.

Samuel L. G. Knox has been granted patent No. 1,590,835 for an apparatus for sighting guns. This apparatus is intended primarily for sighting guns on shipboard.

Small Arms

The following patents relate to firearms:

Carl G. Swebelius, assignor to Marlin Firearms Corporation, has been granted patent No. 1,578,777 for a firearm. The invention consists in the provision of a special form of ejector which is so placed that it will not catch on the cleaning end when the rifle is being cleaned.

Crawford C. Loomis, assignor to Remington Arms Company, Inc., has been granted patent No. 1,579,177 for a firearm. The invention aims to provide a lock for the action bar of such a character that actual firing of the shell in the chamber must be had before release of the lock.

Patent No. 1,579,742 has been granted to Rudolf von Frommer for an automatic firearm. This invention provides a compact arrangement of the retreating springs for the firing mechanism of an automatic pistol.

Patent No. 1,580,406 has been issued to John M. Browning for a support for firearms. The device covered by this patent is a specific form of tripod.

John D. Pedersen has been granted patent No. 1,580,852 for a firearm. The invention relates to a means for regulating the passage of cartridges from a storage chamber or magazine to the conveying mechanism or feed.

Patent No. 1,580,968 has been granted to Ascanio di Brazza, for a firearm with a screwed barrel detachable by hand or permanently fixed. This invention consists in replacing the checking collar on the barrel by a sleeve which acts as a lock nut.

Bradley S. McIntosh has been granted patent No. 1,582,063 for a sighting rib for firearms. The object of this invention is to provide a demountable sighting rib which may be applied to any firearm.

Ralph G. Packard, Jr., has been granted patent No. 1,582,533 for a bolt gun. The main features of this invention reside in improvements in details of construction.

Patent No. 1,582,673 has been granted to Frank A. Fahrenwald for a rifle bullet. This bullet is made of copper annealed after fabrication.

Louis P. Smith has been granted patent No. 1,583,616 for a gunstack fastening. The patent covers a specific means for fastening a gun stock.

Books

Our Times, The United States 1900-1925. Vol. I, The Turn of the Century. By Mark Sullivan. New York: Charles Scribner's Sons. 1926. $5.00.

IT IS difficult to conceive of a history of the age in which we have lived being written in a more satisfactory and enjoyable style than this book. Anyone who reads this first volume covering the first four years of the present century will impatiently await the volumes to follow.

Here we have an all embracing picture of the United States in the spheres of polities, religion, science, art, society, literature, with statistics set down in such manner as to be delightfully entertaining. Nothing which is pertinent and of moment is omitted. It is typical that people who have been a part of a function of one kind or another enjoy reading the accounts of what was done, of pouring over pictures of the event, and reminiscing in later years about it. "Our Times" is your personal album and diary combined of the books you read, the songs you sang, the games or sports you enjoyed, the popular heroes of the hour, the political aspirants of the day. No one who is thirty should fail to read what Mr. Sullivan has so ably written. He should also make it possible for his children and grandchildren to read this absorbing epic.

As a record of an age and as a reference book it is more intriguing than most novels. No one can fail, after reading this book, to understand thoroughly the many issues which influenced the daily national life during these important years, nor will he fail to stick out his chest with the knowledge that he has lived, has been a part, of such an era in the life of our nation.

This is history of contemporary times written without the usual lapse of years to ripen the thought of the historian. Written fearlessly, conscientiously, a commendable undertaking showing intimate knowledge of political issues and political leaders, and withal written with a fine journalistic aptitude to present what is most significant, interesting, and epochal. Many foot notes and references with an ample index add to the value of the book. It is unqualifiedly recommended to be owned and read by every American.

ARTHUR W. FORD.

Paris, or the Future of War. By Capt. B. H. Liddell Hart. London: Kegan Paul, Trench, Trubner & Company, Ltd. 1925. 2s6.

THIS interesting little book is one of the To-day and To-morrow series published by this company and is an essay concerning the ever present controversy of the most effective arms or services in future wars. It has generally been conceded that a successful general was a deep student of past wars and of the principles of war as enunciated by such outstanding characters as Napoleon and Clausewitz.

It is here pointed out that these generals visioned a false objective, namely, "the destruction of the enemy's main forces on the battlefield," whereas the true and national objective is "to subdue the enemy's will to resist, with the least possible human and economic loss" to the nation. Hence, it is stated, it is best to discard the older principles of war based on the desire to attain the false objective and to organize for war with the moral objective in mind, and to use the best means for that purpose. These means can be exercised in the military, the economic, the political, or the social spheres, employing the weapons of military, economic, or diplomatic usage.

The various factors entering into the question are very ably discussed and the conclusions drawn, that in future wars the dominating arm will be *aircraft* carrying gas to "strike direct and immediately at the seat of the opposing will and policy." To supplement this air weapon until it reaches maturity, are, the naval weapon, in the form of a submarine blockade, and the army weapon in the form of highly mobile tanks. The death knell of other combatant arms is sounded and we have "the late infantry," "mausoleums of mud built by Clausewitz and his successors," etc.

The book is clearly and logically written and should be interesting to civilians and fighting forces equally, especially in view of the contemporary wars being waged in various countries and the prominence now being given to the question of an increased Air Service in the United States, with its attending increase in the National Budget.

ARTHUR W. FORD.

Power Possibilities at Muscle Shoals. By Samuel S. Wyer. Reprint of Paper Presented at Annual Convention of Electrical Engineers, Saratoga Springs, N. Y., June 22 to 26, 1925.

THIS is a well prepared paper giving in brief form the more essential facts in regard to Muscle Shoals power, facts which everyone who attempts to come to conclusions in regard to this project should have at hand.

The author has written under three main headings as follows: I Fundamental Features; II What Has Been Done to Date; III What Can Be Done at Muscle Shoals.

A map is given of the Muscle Shoals district and another of the drainage basin of the Tennessee River above Muscle Shoals. A chart is also included showing the daily flow and horsepower of the Tennessee River at Muscle Shoals and another chart showing the comparative magnitude of the water power at Muscle Shoals and that at Niagara Falls, and the potential undeveloped water power of the United States.

The U. S. Nitrate Plant No. 1 and U. S. Nitrate Plant No. 2 are mentioned in short paragraphs only. The recent

development in nitrogen fixation has been passed over hurriedly, perhaps too hurriedly even in a paper devoted to power, for changes in this industry might well be a deciding factor in determining what use shall be made of energy developed at Muscle Shoals.

This paper is recommended to those who contemplate a study of the Muscle Shoals problem. P. E. Howard.

The Historian and Historical Evidence. By Allen Johnson, Professor of American History, Yale University. New York: Charles Scribner's Sons. 1926. $2.00.

THIS book is written in a very readable and brief but comprehensive style which makes it delightfully instructive. While it is mainly concerned with the historical view point, the various methods of deduction and weighing of evidence are equally applicable to other studies.

"The Sources of Information" are brought to mind in the first chapter where the attention is focused on the many varied sources to draw on for historical information. Traditions, tapestries, newspapers, diaries, etc., are not of equal testimonial value and often the evidence given by two or more sources is conflicting, which at once raises the question of doubt. "The Basis of Historical Doubt" is the subject of the second chapter, in which is shown that the process of perception is not so direct and simple as one would suppose. Numerous examples are cited of greatly varied accounts by different witnesses describing the same occurrence, showing the basis for the tendency of legal procedure to give less and less weight to the probative value of testimony and more and more to realistic or circumstantial proof. In chapter three, "Technique of Historical Criticism," are reviewed the pitfalls that beset the historian in the form of plagiarisms and forgeries, and the motives for such deceptions.

"Historical information transmitted by an active intelligence is bound to be somewhat deflected from the exact truth. No human mind is infallible. Every man is a child of the age, a creature of his environment, and subject to conditions of time and place. What these conditions are in any given case must always be ascertained," says Professor Johnson, and so in the next chapter is discussed "The Assessment of Evidence."

The subjects of the last three chapters are "The Evolution of Method," "The Nature of Historical Proof," and "The Use of Hypotheses." The methods of the quest for historical truth is as fascinating as the modern detective story, and we wonder with Professor Johnson, "given the limitations of human perception and memory, and the fallibility of human testimony, how can any certain knowledge of the past be gained?" For example, note the current controversy concerning the character of our first President. Professor Johnson credits Fontenelle as remarking that history is a fable that men have agreed upon.

The author is a thorough master of his subject and the value of this exposition of the evolution of historical research is enhanced by numerous references throughout which form a bibliography of pertinent texts and which may be consulted by means of an index of authors at the end. Arthur W. Ford.

The School for Ambassadors. By J. J. Jusserand. New York: G. P. Putnam's Sons. 1925. $3.50.

ENGINEERS and executives, including Ordnance officers, as a class are not suspected of reading poetry and fine literature, much less of writing either. They are commonly supposed to immerse themselves in their spare time in huge mathematical treatises, to use the long equations and combinations of calculus for playthings, and to find their great enjoyment in the complexities of mechanics and chemistry. Without taking up the romantic side of mathematics, though I reserve the right to insist that it exists and is most entrancing, I must confess to have discovered not only poets and artists among our mechanical and chemical engineers, but to have found in their libraries, well thumbed volumes of Racine, Ronsard, Maeterlinck, Lessing, Schiller, Shakespeare, Hearn, Dickens, John Burroughs, Ruskin and Sarah Teasdale. Without hesitation, therefore, I offer to them in this engineering journal a glimpse into another delightful volume, Jusserand's "The School for Ambassadors."

This book is just a melange of little journeys over the trails where the beloved authors of Jusserand's library have walked and talked. Continuity between the stories is unnecessary and does not exist. Each of the nine essays is written at different times, under different skies, upon different themes, written with scrupulous care as to facts and figures, verified often by personal investigation on the ground or by quoted references from other authors. They are written for the sake of fine writing and above all with unconcealed delight on the part of the author over the revelations of his investigations. Each one, except the sixth, is long enough for an hour's reading and thought. Altogether, with the index, they fill over three hundred and fifty pages of pleasant historical literary entertainment. These are his subjects:

I. The School for Ambassadors,
II. At the Tomb of Petrarch,
III. "Sainct Treigney ou Pais de Gales",
IV. A Duke and His City. Vespasiano Gonzaga, Duke of Sabbioneta,
V. Ronsard and His Vendomois,
VI. "Tennis",
VII. Winter's Tale,
VIII. Ben Johnson's Views on Shakespeare's Art,
IX. What to Expect of Shakespeare.

As an appendix to the second essay, he has added many thoughts to show that Chaucer one time met the great Italian poet, became his friend and admirer and used his themes and knowledge.

The first essay is in one way biographical, for it reveals the sources of Jusserand's rules of conduct for an ambassador, his personal opinions of an ambassador's duties and those qualities of heart and mind which he displayed during that long and distinguished career in Washington, and which counted so happily in the relations between our country and his.

The next four are observations on the countries through which he traveled with his subject in mind, the landscape that touches that subject, the poetry, prose, and song which refer to it, the people who played memorable parts and their habits and customs, and the influence of his subject

in after years upon the political, literary and religious affairs of the world. They are much more than this indeed. The reader will find more and chuckle with contentment at the happy thoughts on Petrarch, Regnault Girard, Vespasiano, Gonzaga and Ronsard, thoughts which will be new to him and admirably expressed to him by a sympathetic and understandable author.

One insert amid the more learned essays indicates the variety of subjects to which this great student diverts his extra-official thoughts. It is inquiry into the history of the word "tennis" as applied by the English to our national game instead of the French word "paume," which designated the game in older times. He does not, however, make a complete answer nor explain the peculiar scoring system.

It is doubtful whether anyone but a research student would select his essay, "Winter's Tale," for entertainment. It is, nevertheless, a rambling study of an interesting phase of Shakespearean art.

In his next essay, he enjoys the comparison of Ben Jonson and Shakespeare, one, the bombastic, self centered, confident writer of verses and plays who commanded the world's attention and fought its criticism; the other, a simple maker of plays for players and theatergoers, who published nothing of plays and paid no attention to literary criticism, favorable or unfavorable, perhaps never read it, but watched the faces in the pit to see when they smiled and wept, when human passions were stirred by the make-believe of his own contriving.

The same tone follows through the author's speech or essay, entitled, "What to Expect of Shakespeare." This one gives a pleasant touch to the reading of all his plays. Jusserand conceives the great Will at his writing table going at great speed, stopping never once to correct or erase, hesitating not once to consult his atlas or map, going on regardless of errors, thinking only of the effect upon his hearers in the theater; out of his fertile brain, raising new personages and endowing them with histrionic power, borrowing here from the tales of the inn and there from the older plays and stories, but with this one single purpose, that Will Shakespeare may please, and having pleased and collected for the pleasure given, to retire to Stratford and be a great man of his little town. Yes, "to be first in the little Iberian village rather than second at Rome." Will Shakespeare, Esquire, away from the stage, the critics and the stuffy rooms of London, out in the freer beflowered countryside of Stratford, with its gentle people and quieter, simpler run of life, that was the spur of the greatest author of plays, and the thing which he actually accomplished and enjoyed as he had anticipated.

These essays are in the learned style, full of many quotations of this author and that one, but all to the point of the author's intention, well expressed, pleasingly assembled, neatly and accurately printed in good type and worth many evening hours at home. C. G. METTLER.

Dependent America. By William C. Redfield. New York: Houghton Mifflin Company. 1926. $2.50.

ALL Americans know that our country abounds in natural resources and that our industries lead the world in more ways than that of mere magnitude. The majority of our citizens also firmly believe that our country could be absolutely self-contained if the necessity should arise. However, such "one hundred per cent Americanism" can be readily qualified by anyone who stops to turn over in his mind the question of the economic independence of the United States. The United States is undoubtedly more nearly self-contained than any other country, except possibly Russia, but it is also true that no nation can be absolutely self-contained but must reach out to the rest of the world for some of the things it requires.

To what extent does the United States reach out to the rest of the world for its needs? What are the products we require? How do they enter into our everyday life? Are there substitutes within our borders? The author, who will be recognized as a former Secretary of Commerce, has analyzed in this book the economic dependence of the United States on the rest of the world. In the third chapter, for example, is shown the dependence of our greatest industry, that of steel, on other parts of the world for manganese, chromium, nickel, tungsten, and vanadium. Other chapters deal with many other foreign produced materials which we practically consider necessary for our comfort and efficiency. The last chapter fittingly covers the question of national defense and shows our dependent position in the matter of strategic raw materials. This chapter is based on information furnished by the War Department and brings home to the reader our economic insufficiency in the face of national peril. It is interesting to note that one of the documents used in preparing this chapter was a study of raw materials made in the Ordnance Office in 1924.

Mr. Redfield has ably presented an authoritative account of the extent of the dependence of the United States on foreign lands, well worth the attention of the student of international affairs, who is searching for further information on the relation of trade to international polities and to national policies. E. E. MACMORLAND.

The Perils of Amateur Strategy. By Lieutenant-General Sir Gerald Ellison, K. C. B., K. C. M. G. New York: Longmans, Green & Co., Ltd. 1926. $2.00.

THIS little volume comes at an opportune moment, as the theme which Sir Ellison develops has a direct bearing on two important defense questions now being studied in Congress, viz., a separate Air Service and a Department of National Defense, or in lieu thereof, a Council of National Defense. Persons advocating adding new loosely co-ordinated departments (as a separate Air Service) to

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our system of national defense will find therein many arguments against it which are based on experience in the World War. Judged alone by the number of publications here and abroad dealing with the Dardanelles Campaign there is reason to believe that it will soon be the classic example of how Democracy should not go to war just as much as the early battles of the Civil War are the classic examples of what can not be done by a million men sprung to arms overnight. Our own Walter H. Page is quoted in the introduction as follows: "The horrible tragedy of Gallipoli, where the best soldiers in the world were sacrificed to politician's policies."

This brings us to what the reviewer considers the author's most important criticism. He shows that Great Britain (as well as most other democracies) makes war by the method which he designates as "Sanhedrim control" which essentially consists in having well-organized separate departments of the land and naval forces with professional staffs, and an unorganized and unstaffed industrial-economic system, all commanded and strategically handled by politicians (or statesmen, as one likes) *unsupported by a professional staff holding a brief for none of the component departments.* The reviewer does not agree with Sir Ellison that it is practicable, in a democracy, to take the higher strategy out of the hands of the civil powers or to separate the economic phases from the military in the higher command, but this same civil power (in Britain the Prime Minister, with us the President) should certainly be provided with a full professional advisory staff trained in time of peace to advise the chief executive on the proper co-ordinated use of all the country's war-making agencies just as a general staff officer advises his general on the use of the combined arms of a division or army. History teaches us, as is shown by the author, that the great democracies have muddled through because after the failure of their peace-time system a strong man has nearly always come to the top after the initial failures and replaced with his personality what the system lacked; this gains success in the end but at a price.

Winston Churchill makes a good case for himself in "The World Crisis" as a man of initiative, energy and intelligence, and it is thought that the blame should lie not so much on him as on the Prime Minister who should have ascertained how the British Army felt about it, whether it would affect the munitions supply, whether the main theatre of the war (in France) would be affected and how France felt about it. However, as the Prime Minister had no unbiased super-staff to advise him he naturally succumbed to his zealous and energetic minister, thus showing that England mainly has her system (or lack of it) to blame for what took place.

This book brings out two minor but very important topics in support of the main argument, the first of which is that purely naval attacks on land fortresses of even mediocre strength can have but little immediate chance of success and no chance of permanent gain to the cause. This conclusion, which is increasingly supported by history, has had just enough brilliant exceptions to it to tempt the more adventurous of leaders. The first phase of the Dardanelles Campaign, the naval action, was predestined to failure, but this would have been of small moment had the campaign stopped there. A combined attack by the Army and Navy was a proper procedure from a tactical standpoint, although improper strategically, had not the naval attack occurred first so as to give the enemy time to prepare. The author relates that the land and naval forces actually engaged at Gallipoli had good "team work," which is certainly the exception rather than the rule in such joint un-co-ordinated attacks.

The second minor subject is the strategical and tactical error involved in the whole Gallipoli affair as a minor campaign which was large enough to weaken the main forces in France both as regards men and munitions. This diversion together with others of the Allies laid them open to being beaten in detail and violated the fundamental principle of the concentration of forces. The author shows the danger that such a theory involved in this case and quotes the objection of the Sir John French, commanding in France, to the whole scheme. The author, while advocating unity of command for all Britain's war making forces, does not touch at all upon the defective corner stone of the whole structure as far as the World War was concerned at the time of the Gallipoli affair, that is, the complete lack of unity of command for the Allies, even as regards the military arm, to say nothing of munitions and other departments. A strong unit command of all the Allies would probably have prevented the attack on the Dardanelles at that time as a diversion weakening the main and deciding action in France.

In general, it may be said that the book is well written and arrives at logical conclusions. It is thought appropriate to quote the following which the author prints in bold face type: "The Gallipoli campaign will stand for all time as a classical example of disjointed action by a navy and army, of national forces being thrown into battle piecemeal and being defeated in detail, of one service being dragged by the action of another service into an operation which proved its undoing." It is sincerely recommended to all who are interested in national defense and in increasing the efficiency of our nation as a war-making machine when war is forced on us. The argument for some form of competent national unity of command is shown to be unanswerable.

John K. Christmas.

Pegasus, or Problems of Transportation. By Col. J. F. C. Fuller. New York: E. P. Dulton & Co. 1926.

THIS stimulating little volume is divided into two sections, namely, "The Battle of the Iron Horse" and "The Conquest of the Elyssian Fields." Both are extremely interesting and though highly imaginative still have practical application to the problems of the age. We may look forward, says the author, to discoveries and inventions in the field of transportation which are as far in advance of the present age as Stevenson's "Iron Horse" was to the cen-

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turies preceding its invention. As ludicrous as transportation by ether waves may seem to us to-day, it perhaps appears no more impossible to us than the steam engine did to the English layman, scarcely a century ago. The author implies a challenge to the statement that anything is impossible.

Transportation, he argues, is the basis of development and civilization. Hand in hand with it moves the progress of nations, and all the natural resources of the world mean little, if transportation is not near at hand. To illustrate, an abundance in one land is of no value to a starving nation if facilities are not available to bring the two together. Prosperity, then, one might conclude, is directly a function of transportation.

There is also discussed with clear logic the unemployment problem, which is of such concern to the European nations, including Great Britain, and a solution offered which labor leaders might well consider to-day. This proposed solution lies in the development of the dominions and possessions through transportation so that man may sell his produce and at the same time have within his reach the pleasures of modern life. It is the employed, not the unemployed, which must emigrate from congested areas, for only the experienced possess the means of success. Of course conditions determine the most suitable method of movement in any land and, it is therefore realized, that many types of transportation are required—but each having its tune and place.

The book quite naturally is British in its style and atmosphere. The section on "The Battle of the Iron Horse" is built entirely around Stevenson and his invention of the steam engine. The second section on "The Conquest of the Elyssian Fields" is essentially a study and analysis of British conditions, but not without its application to other nations. "Pegasus" is a well chosen title for the volume, and in itself suggests a story by a man with a keen imagination.

G. A. Stoup.

Aircraft Instruments. By H. N. Eaton, A. M.; K. Hilding Beij, B. S.; William G. Brombacher, Ph. D.; W. Willard Frymoyer, B. S.; H. B. Henrickson; C. L. Seward, B. S.; D. H. Strother, M. S. All of the Aeronautic Instrument Section, U. S. Bureau of Standards. A Volume of the Ronald Aeronautic Library, C. deF. Chandler, Editor. New York: The Ronald Press Company. 269 pages. $5.00.

IT IS necessary to make use of a large number of instruments to obtain a maximum performance from aircraft. Information concerning these instruments has been obtainable largely only from actual use and from special reports on individual instruments. In "Aircraft Instruments" the personnel of the Aeronautic Instrument Section of the U. S. Bureau of Standards has performed a service to those interested in aircraft by briefly describing the many different types of instruments which are used on modern aircraft. This book is made especially valuable by many references to articles on aircraft instruments, thus enabling those who are interested to go more deeply into the subject.

The large number of specialized instruments which have been developed for aircraft would surprise those not familiar with the aircraft instrument field. They include instruments for measuring altitude, climb, airspeed, ground speed, direction, position, engine speed, temperature, pressure, and gasoline level; manometers, special instruments for airships, instruments for measuring gas and air temperatures, navigating instruments, oxygen supply instruments and special test instruments. In a single volume it is only possible to cover any one instrument in a very brief fashion and to one interested in a particular instrument the information furnished may seem rather meager. He is, however, at liberty to consult the many references which are cited. The chapter on Altitude and Climb Measurement is especially good, covering altitude formulas, calibration standards, errors in altimeters, the principle and operation of various types of altimeters and the description and theory of rate-of-climb meters. The various means of measuring airspeed are also well described. The chapters on Direction and Position Instruments and Power Plant Instruments are rather brief, and proper consideration is not given to the use of these instruments in service. For example, in describing various types of tachometers no distinction is made between those which are and those which are not suitable for aircraft use. It is believed that this book might have proved of more value to the average person interested in aircraft if greater stress had been placed on the instruments most commonly used and less on special instruments such as those used in lighter-than-aircraft and navigation of which only a few models have been built and which will probably never be used in general service. The book is concluded with a useful appendix on conversion factors and constants and model instrument specifications.

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American Society for Testing Materials: Proceedings of the Twenty-Eighth Annual Meeting. Volume 25, in two volumes, Part I—Standards, and Part II—Technical Papers. Per volume: paper, $6.00; cloth, $6.50, and half leather, $8.00. Published by the Society, Philadelphia. 1926.

THE contents of Volume I are in three main parts. First, the reports of the various subcommittees investigating specific types of materials with discussions thereon; there are thirty-five such reports. Ordnance officers will be particularly interested in the report of the subcommittee on X-ray metallography, which process is being actively investigated and used by the Ordnance Department. Watertown Arsenal is given due credit for its valuable contributions in this field as evidenced by the following quotations: "Results achieved, so far as they relate to foundry problems, have been for the most part obtained in the testing laboratories of Watertown Arsenal where an X-ray section was installed in the fall of 1922 for metallurgical research and radiographic testing. Due to the fact that this was a pioneer laboratory the first problem of importance was the development of a suitable laboratory technique." Secondly, there are the "new and revised tentative standards" which were submitted or added at the 1925 annual meeting, of which there are eighty-three. Those of particular interest to Ordnance officers pertain to ferrous metal alloys, preservative coatings, petroleum products and lubricants and waterproofing. The work on standards for lubricants is of particular interest now that the Ordnance Department is investigating automotive engine lubrication. The third main division covers tentative revisions of existing A. S. T. M. standards.

Volume II contans twenty-six technical papers with discussions. The general subjects covered are metals; cement, concrete, gypsum and brick; bituminous materials; paint; textiles and specifications. The most interesting paper from a military-technical standpoint is no doubt the one on "The Purchase of Materials on Specifications," by Dean Harvey of the Westinghouse Electric & Manufacturing Company. Since the Army is required to procure by competitive bidding on specifications it is interesting to note that this manner of buying finds favor with many of our largest corporations, who use this method of their own choice.

JOHN K. CHRISTMAS.

The Chemistry of Leather Manufacture. By John Arthur Wilson. New York: Chemical Catalog Company. 1923. $5.00.

THE ART of leather making reached a fair degree of perfection at a very early date, but its evolution as an art is difficult to follow due to secrecy and lack of accurate records. An industry developed as an art presents difficulties to the chemist entering the field, inasmuch as he is forced to study and explain the mechanism of each step of a successful process without interfering with operation. The chemist must realize that the science of the artisan is reliable and must be recognized, and that the utility of chemistry lies in its ability to improve processes; not to replace the art. The collection and study of fundamental data points the way to improvements in process, and the necessity for such research is apparent in the leather industry.

This book is extremely well written, treats the subject in a concise, logical manner, and is regarded as an important contribution to the literature of leather manufacture.

GORDON TIBBETTS.

Balloon and Airship Gases. By Lieut. Col. C. DeF. Chandler, U. S. A., Retired, and Lieut. Walter S. Diehl (C. C.), U. S. N. New York: Ronald Press Co. $4.00.

THIS book is the second of a series of volumes to be published by the Ronald Aeronautic Library, edited by Lieut. Col. C. DeF. Chandler, U. S. Army, Retired, and former Chief, Balloon and Airship Division, U. S. Army Air Corps.

Part I of this book, written by Colonel Chandler, describes the properties of hydrogen and helium gases, the methods of production, the handling of these gases, including their compression, storage, and transportation, and includes a description of practically all equipment used in connection with hydrogen and helium gases.

Part II of this volume, by Lieutenant Diehl, covers the physics of gases, with many tables included, which are not found elsewhere and should be of reference value to physicists.

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1924	Kanawah	Towboat	60
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